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EVALUATING SOURCING STRATEGIES IN EVOLVING COMMODITY MARKETS

Case Neste Oil Oyj

Master's thesis
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ABSTRACT

The objective of this research is to form a framework that can be used to evaluate sourcing strategies in evolving commodity markets. The aim is realized by first determining the intermediate sourcing strategies that exist between spot markets and vertical integration and by defining their characteristics. This information is then combined to the attributes of evolving commodity markets and shaped into a framework that specifies internal and external circumstances that support using a specific sourcing strategy.

The theoretic base for the framework is developed from academic literature on sourcing strategies, transaction cost theory and intermediate modes of governance in supplier-customer relationships. The attributes of evolving commodity markets are imported from the global vegetable oil markets. These markets have been analysed in the case study by gathering information from industry specialists and publications. The case study itself investigates the applicability of the framework in decision making and possible raw-material sourcing strategies for Neste Oil's production of renewable diesel.

The framework is supported by the findings in the case study. Rising availability concerns and misalignment of incentives between the supplier and the buyer can be addressed by increased cooperation and shared ownership arrangements. Whereas high flexibility in sourcing company's operations discourages upstream integration, the increased specificity in raw-material requirements supports closer ties with the suppliers. The case study analyses three specific strategies for the time period of 2010-2015 from Neste Oil's perspective: sourcing palm oil with long-term contracts, integration to oil palm cultivation and integration to soybean crushing. The first is found to provide more power in addressing availability and sustainability concerns than long-term contracts. The third strategy is considered unattractive for a biofuel producer.

Keywords: sourcing strategy, commodities, transaction cost theory, biofuels, vegetable oils
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TIIVISTELMÄ

Tämän tutkimuksen tavoitteena on muodostaa viitekehys, jota voidaan käyttää hankintastrategioiden arvioimiseen kehittyvillä ja muuttuvilla hyödykemarkkinoilla. Tavoitetta on lähestytty etsimällä kirjallisuudesta erilaisia hankintastrategisia vaihtoehtoja sopimusten ja oman tuotannon väliltä sekä määrittämällä eri vaihtoehtojen piirteitä. Teoreettinen tieto ja kehittyvien hyödykemarkkinoiden piirteet on muotoiltu viitekehykseksi, joka osoittaa hankintastrategioiden soveltuvuutta erilaisissa liiketoimintaolosuhteissa.

Viitekehyksen teoreettinen tausta perustuu akateemiseen kirjallisuuteen hankintastrategioista, transaktiokustannusteoriasta ja erilaisten hankintasuhteiden hallitsemisesta. Kehittyvien hyödykemarkkinoiden piirteet on johdettu case-tutkimuksessa esillä olevista kasviöljymarkkinoista. Casen tiedot markkinoista on kerätty alan asiantuntijoilta ja julkaisuista. Case-tutkimus itsessään analysoi viitekehyksen soveltuvuutta yritysten päätöksenteon apuvälineeksi sekä mahdollisia strategioita Neste Oilin biopohjaisen dieselin raaka-ainehankinnassa.

Case-tutkimuksen löydökset tukevat esitettyä viitekehystä. Omistussuhteisiin ja yhteistyöhän perustuvat strategiat tarjoavat apua saatavuusongelmiin ja hankintasuhteen epävarmuuteen. Suhteen kehittäminen ei ole houkuttelevaa jos ostavan yrityksen prosessit ovat hyvin joustavia, kun taas tarkat raaka-ainevaatimukset tukevat läheisempää yhteistyötä. Case-tutkimuksessa analysoidaan seuraavia Neste Oilin hankintastrategisia vaihtoehtoja välille 2010-2015: palmuöljyn hankinta pitkillä sopimuksilla, palmuöljyn viljelyyn integroituminen ja soijapavun puristuskapasiteetin hankkiminen. Ensimmäinen näistä kolmesta havaittiin sopimuksia tehokkaammaksi tavaksi hallita saatavuuden ja kestävän kehityksen ongelmia. Kolmannen vaihtoehdon menestyksekäs toteuttaminen on haasteellista Neste Oilille.

Avainsanat: hankintastrategia, hyödykkeet, transaktiokustannusteoria, biopolttoaineet, kasviöljyt
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1 INTRODUCTION

Determining the optimal boundaries for organizations has attracted academic discussion for decades. The path breaking research by Ronald Coase (1937; in Domberger, 1998: 14) concludes well the discussion to the question: "Why is not all production carried on in one big firm?" Coase's question above has remained relevant throughout the years, but, as Domberger (1998: 14) points out, it took forty years before the analysis of organizations became mainstream activity within the economics profession. During these years we have seen times when the world's leading corporations have been horizontally and vertically integrated giants, but also times when they have been challenged by efficient networks of players that concentrate on their core competencies. Correspondingly, management literature has followed the success of different strategies and at times emphasized different economies of scale and scope (Domberger, 1998: 14).

The success of such different organizational structures has inspired areas of research that study the drivers behind vertical integration. Vertical integration can be seen as the degree to which a company owns and controls its neighbouring stages of production or distribution (Perry, 1989). Then again, especially under the topic of upstream integration, many researchers view integration as a black and white make-or-buy decision. Perry's (1989) definition above allows also a wider spectrum of hybrid strategies that incorporate elements from both contractual relationships and ownership. In other words, many shades of grey exist between the polar opposites. Heriot and Kulkarni (2001: 18) similarly point out that much of the existing literature neglects these intermediate sourcing strategies that lie between full ownership and purchasing from spot markets. Furthermore, their study confirms that firms use intermediate sourcing strategies more frequently than the polar strategies.

Coase's (1937) pioneering work on organizational boundaries was brought again into spotlight by Williamson (1975), who has since been one of the main contributors in the area of transaction cost economics. By mid-80's, transaction cost economics had evolved into an empirical research program that progresses in the areas of economics such as managerial science, but also in sociology (Ménard, 2004: 346). The theory of transaction costs argues that companies select the mode of interfirm collaboration through assessing the relative cost of internal versus external exchange. Majority of the research in vertical integration uses transaction cost theory to study the polar opposites

of make-or-buy decision, but as Ménard's (2004) study shows, the theory is also widely popular in studying hybrid organizations. Still, the discussion on hybrid organizations is yet to enter transaction cost economics in large scale. As a consequence, the majority of the academic literature settles to accept the existence of a strange group of organizational structures that cannot be categorized as "make" or "buy". Ménard (2004: 346) declares that some academics even question the importance of studying hybrid organizations. Perhaps the vast and heterogenic array of hybrid strategies is not seen as a stable grounding for the theory on vertical integration.

The wide use of hybrid strategies in business and the early stage of studies in hybrid organizations have created a gap between the theory and practice. Managerial literature on vertical integration follows the research on transaction cost theory and in many cases settles for noting the existence of strategies between full ownership and spot markets. The readers are rarely provided any clear set of possibilities between the opposites and their applicability in different circumstances, yet the management decisions they make often result in using intermediate sourcing strategies. This creates a clear demand for categorization and evaluation frameworks for hybrid strategies of organization.

1.1 RESEARCH OBJECTIVES

The aim of this study is to create a framework that helps managers to recognize and evaluate available strategic possibilities in upstream integration. The scope of the framework has been selected to be on evolving commodity markets. The objective is divided into two specific research problems.

I. What are the intermediate sourcing strategies that exist between vertical integration and spot markets?

II. What kind of internal and external circumstances encourage using specific sourcing strategies?

The problems are addressed by reviewing the literature on hybrid organizational forms to identify specific intermediate sourcing strategies and their characteristics. The position of a strategy on the continuum between "make" and "buy" is judged by its correspondence to the elements of polar strategies in transaction cost theory. The framework is created by incorporating practice to the theoretical approach. This results in scenarios that point to attractive strategies in specified circumstances.

The framework allows managers to use their knowledge and future projections to align the sourcing strategy with the surrounding conditions. The applicability of the framework is investigated in a company case where three different sourcing strategies are compared in different future settings. The company in focus is Neste Oil Oyj, a Finnish oil refining and marketing company that has recently extended itself into biofuel production.

Case Neste Oil provides an interesting setting for analysing different sourcing strategies. Neste Oil identifies its core competence to be the production of high quality fuels for cleaner traffic from a variety of low-cost raw materials (Neste Oil, 2007). The company has set up its objectives to become the world's leading producer of biomass based diesel. The raw material supply has emerged as one of most important areas of production and has forced the company to consider the possibilities regarding upstream integration. Rapidly increasing raw material demand in both food and biofuel industries has created the threat of availability problems. The supply sector has responded by increasing the availability, but in some cases this has lead to unsustainable production practices that cause problems such as depletion of rainforests. The objective of the business case is to analyse potential sourcing strategies that could help Neste Oil to operate profitably in the environment of raw material scarcity, soaring prices and sustainability issues.

As the discussion above noted, real life companies tend to use intermediate sourcing strategies more often than full ownership or spot purchases. At Neste Oil it is seen that mere spot purchases cannot address the raw material concerns and on the other hand, integration to upstream through full ownership is as a very challenging option. Neste Oil does not have history in agriculture, the mature vegetable oil markets are controlled by few global conglomerates and industrial production of biomass is seen to be possible in large scale only near 2015. As a consequence, studying the intermediate alternatives is a current topic for the case company as well as for other companies facing similar challenges.

The perspective of this study builds from the case study. It concentrates on the markets of commodities that are produced in industrial scale. This may limit the applicability of the framework in service markets. A transaction is seen to occur between two companies that operate on markets where the number of players on both supply and demand side are in the same category. In other words, the results of this study may not be applicable when analysing markets of few buyers and a high number of suppliers or

vice versa. As upstream integration requires medium to long-term commitment, this study concentrates on the purchasing of frequently used inputs that can be further categorized as strategic or be used to achieve competitive edge. As many of the views are based on the characteristics of evolving markets, the resulting framework may not apply to mature or declining markets.

This study does not aim to provide an extensive literature review in the topic of transaction cost economics, but instead uses selected studies to form the basis of the framework. The framework is reviewed by a qualitative analysis of Neste Oil's possible sourcing strategies and therefore only briefly touches the financial calculations related. In addition, readers interested in a sociological perspective to hybrid organizational forms are guided to the survey by Grandori and Soda (1995) as the perspective in this study remains mainly economic.

1.2 ORDER AND CONTENTS

The order and contents of the following chapters are designed to lead the reader from the basic research on vertical integration into a more specific area of interest, the intermediate strategies in upstream integration. The basics are then combined with the characteristics of evolving commodity markets to create a framework. The following text investigates the applicability of the framework by analysing Neste Oil's raw-material sourcing.

Chapter 2 builds basis for the framework presented in this study. First, upstream integration in general and its applicability as a sourcing strategy is discussed. The basic assumptions are followed by a view on the research on upstream integration in transaction cost economics. Finally, the focus moves more into hybrid sourcing strategies and their categorisation

Chapter 3 introduces the framework that portrays different types of hybrid sourcing strategies and their use in evolving commodity markets. The aim of the framework is to support managers in decision making regarding sourcing strategies.

Chapter 4 analyses the relationship between the case company and its evolving raw-material market. The strategies selected for further analysis are sourcing palm oil with long-term contracts, integration to oil palm cultivation and integration to soybean crushing. The chapter concludes with suggestions for the case company.

Chapter 5 concludes with a summary of the presented framework, its applicability in actual business surroundings and a view on the possibilities of future research.

Appendices A and B provide information on the structure of the supply chains in palm oil and soybean oil industry. Readers unfamiliar with the markets of these products are recommended to examine the appendices prior to the case study in Chapter 4.

1.3 KEY TERMS

Asset specificity is a term related to transaction cost economics (see *Transaction costs* below). The term describes how specific a certain asset is for a process as the following examples show. Asset specificity is high if a factory has to be located next to a single customer and thus cannot be used to serve other customers. Similarly, a product can be highly specific if it is customized to the needs of a single customer.

Crushing is a processing step in the production chain of seed oils such as soybean oil, rapeseed oil and sunflower oil. The crushing process extracts oil from a seed by mechanical pressing or solvent extraction. The main products of crushing are oil and solid mass, i.e. meal.

Evolving commodity markets are markets that have not yet stabilized and reached maturity. Evolving commodity markets can emerge if a new type of goods is introduced or a mature or declining market faces large changes that create strong growth.

Hybrid organization / hybrid governance is related to the modes of coordination in inter-company relationships. Hybrid organization is used when two parties do not transact on mere spot markets or, on the contrary, inside a single organization. As a consequence, hybrid organization is an intermediate mode of operation between full outsourcing and insourcing.

Sustainability is an attribute of a process or a product. Sustainable production is carried out in an environmentally and ethically sound manner. This includes also non-environmental characteristics such as the rights of workers and avoidance of corruption.

Transaction costs occur when a transaction between two parties is carried out. Transaction costs of contracting consist of the costs of governing a contractual relationship. In cases where transaction costs include also production costs this study refers to total transaction costs. Transaction costs of contracting are studied under the topic of transaction cost economics / transaction cost theory.

2 MAKE-OR-BUY DECISIONS

This chapter discusses the research on sourcing, upstream integration and hybrid organizations to lead the reader from theory to an application, the framework presented in the following chapter.

The theory is divided into three subchapters. Chapter 2.1 studies sourcing in general and the applicability of upstream integration in the sourcing of different types of products and overviews the areas of research that seek to explain the behaviour of companies. Chapter 2.2 briefly discusses the approaches used to study vertical integration and introduces one specific approach, transaction cost economics. Chapter 2.3 digs deeper into the academic literature and scans publications for hybrid organizational forms. In other words, the chapter surveys the intermediate sourcing strategies between "make" and "buy".

2.1 UPSTREAM INTEGRATION

In this study upstream integration is seen as an array of sourcing strategies where the supplier and buyer are committed to the bilateral relationship in a level deeper than the pure transaction for the product. In other words, upstream integration takes place when the buyer invests in resources that bond it to the supplier organizationally. To address the reasons that lead to upstream integration, the creation of a sourcing strategy is discussed. Discussion moves then to briefly review the areas of research that study vertical integration.

2.1.1 CREATING A SOURCING STRATEGY

A textbook approach, take for example Weele (2005: 146), to determining a purchasing strategy starts by two steps. First, the company has to decide which activities to handle inside or outside the company. This decision is based on the fact whether or not an activity contributes to achieving competitive edge. If competitive edge can be achieved, the activity shall be carried out by the company itself, i.e. it is insourced. The second step, after the boundaries of the company have been set, is to develop purchasing strategies for different types of products. The strategy includes guidelines such the standardization level of purchased goods, number of suppliers and type of relationships.

The first step includes determining the core competencies of the company. Prahalad and Hamel (1990: 83) argue that a core competency is an activity that provides benefits to customers, is hard for competitors to imitate and can be leveraged widely in many markets and products. Following Quinn's (1992; in Weele, 2005: 8) view, the activities that are not core competencies of a company should be outsourced as they do not provide sustainable long-term competitive advantage. Outsourcing non-core activities to specialized suppliers can then contribute to cost reduction, quality improvement, lead time reduction and innovation at the same time (Weele, 2005: 8).

A powerful tool for developing sourcing strategies is the purchasing portfolio that can be used to categorize different supply markets from the purchaser's perspective and to determine a suitable sourcing strategy for each market. Purchasing portfolio was originally introduced by Kraljic (1983), but has since been slightly modified by multiple authors. Figure 2-1 presents Weele's (2005: 150) view of the purchasing portfolio. Moving up in the vertical axle increases the importance of the purchased product to the company and moving right on the horizontal axle increases the difficulty to obtain the product. Weele (2005: 153) concludes that partnerships with suppliers are to be sought especially when sourcing strategic products that are critical for the end product's cost price and the dependence on a specific supplier is high.

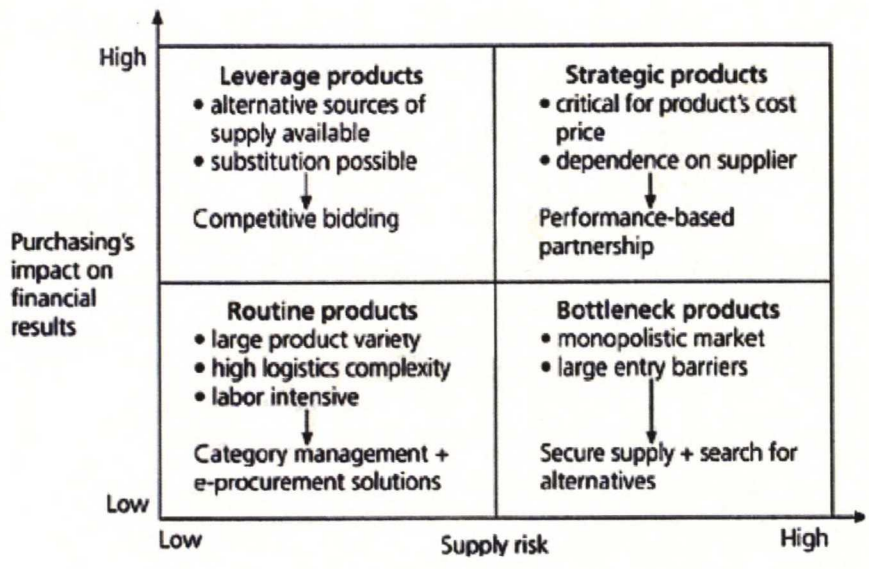

Figure 2-1 Purchasing product portfolio (adapted from Kraljic (1983) by Weele, 2005: 150)

Based on the above approach of determining the supply strategy, upstream integration is most likely to occur if insourcing the production contributes to achieving competitive edge or if the purchased product can be categorized as strategic. The only product

category in the purchasing portfolio where competitive edge is most probably not found is routine products. Accordingly, it can be concluded that purchasing strategies using upstream integration may be viable not only in sourcing strategic products, but also in the purchasing of leverage and bottleneck products if they can provide competitive edge.

2.1.2 THEORIES OF COMPANY BOUNDARIES

The empirical research on what such competitive edge that drives companies to vertical integration can be and how companies seek to mitigate supply and price risks of strategic products is dominated by the transaction cost theory. Prior to the transaction cost approach, the prevailing view among economists was that vertical integration or vertical control was used to pursue monopoly rents (Klein, 2005: 435). This could be achieved by having control of the input markets or distribution channels. Klein (2005: 456) notes that today market power theories continue to be relevant mainly in the antitrust literature. The position of transaction cost economics was less dominant a few decades ago. Perry (1989: 185), for example, applies three broad determinants to vertical integration. First are the technological economies of integration. They can be achieved if integration reduces the need of intermediate inputs, such as transportation or packaging. Second, the study mentions transaction cost theory and its ability to explain the first determinant as well. Third, the market power theories are seen as an important determinant of vertical integration.

Even though the empirical research is mostly based on transaction cost economics, Klein (2005: 456) notes that most of the new theoretical work in economics on firm boundaries is based on the framework of incomplete contracting. The theory was pioneered by Grossman & Hart (1986) and Hart & Moore (1990) and is often referred to as the Grossman-Hart-Moore theory as well as the "incomplete contracts" or "property rights" theory of the firm. The theory is based on the main elements of transaction cost economics, but differs slightly from it in some aspects. Whereas transaction cost theory concentrates on the costs of creating and maintaining an integrated or non-integrated relationship, the Grossman-Hart-Moore theory focuses more on the role of contracts in investing to relationship specific assets. An extensive comparison of these two theories can be found in Williamson (2000).

Although the Grossman-Hart-Moore theory has been successful as a basis for theoretical work, the research on existing modes of hybrid organizations is mainly found around the topic of transaction cost theory. Consequently, this study concentrates on transaction cost economics as the explaining theory of company boundaries. The following chapter discusses the theory in more detail and provides basis for the analysis of intermediate sourcing strategies.

2.2 TRANSACTION COST ECONOMICS

One aim of this research is to determine how the hybrid forms of interfirm relationships relate to each other between the polar extremes of "make" and "buy". For such measurement, we need to identify the polar strategies and their common characteristics. This chapter first explains the main surroundings of transaction cost theory. After that, the empirical evidence is studied to recognize the drivers for purchasing on spot markets and integrating to full ownership.

2.2.1 THE UNDERLYING FRAMEWORK

Transaction cost economics is usually seen as an academic area of research initiated by Coase (1937) and then revived by Williamson in the 1970's. The research around the topic has been lead by Williamson's string of contributions that includes several articles and books dated from early 1970's to the present day. Most of the foundations of the theory have been presented by Williamson's books in 1975 and 1985 (Dietrich, 1994: 21).

The fundamental approach is that both, contractual and internal exchange, produce transaction costs. In a contractual relationship between two parties this means costs of drafting, negotiating, monitoring and enforcing the contract (Heriot & Kulkarni, 2001: 19). According to Dietrich (1994: 21), the costs of enforcing the contract can be divided into (1) costs caused by the contract becoming misaligned with the transaction in the course of time, (2) the renegotiation costs to realign the contract, (3) the governance of the contract when disputes arise (e.g. courts or arbitration) and (4) the costs of bonding the companies together to increase their commitment to the contract.

Transaction costs of contracting are increased by asset specificity and uncertainty in the transaction. If the costs reach a level high enough, insourcing the activity becomes more attractive than relying on contractual relationships. The effect of asset specificity and

uncertainty is increased if the transaction occurs regularly (David & Han, 2004: 41). Asset specificity determines how specific the investments made to the concerned relationship are (Domberger, 1998: 15). For example, asset specificity is low if the production of the exchanged product is not constrained by the location of the buyer or by buyer's specifications. A case of high asset specificity develops, for example, when the supplier's production unit has to be located adjacent to the buyer's premises and elaborated if the product does not have markets outside the bilateral relationship.

Uncertainty in the transaction emerges mainly from bounded rationality and opportunism. Bounded rationality means the inability of the economic actors to write contracts that cover all possible contingencies (Dubois, 1998: 11). Opportunism is defined as "self-interest seeking with guile" (Williamson, 1985: 47), which can basically be seen as a fact that economic actors are primarily concerned with their personal advantage. If asset specificity is high, the possibility of "hold-up" arises. This means that one of the contract parties refuses to continue the contractual relationship unless the contract is changed to be more favourable towards the party that is dissatisfied. However, as critics of transaction cost theory argue (e.g. Ghoshal & Moran, 1996), the opportunism should be divided into attitudes and actual behaviour since they are not necessarily in line with each other. A case of this could be, for instance, a breach of contract that is caused by mere confusion.

While the basic Williamsonian transaction cost theory is prominent in explaining the determinants that cause vertical integration, it lacks explicit reasoning why companies outsource non-core activities. As Joskow (2005: 334) declares: "The attributes and associated costs of allocating resources within internal organization are missing." Domberger (1998: 14) goes back to Coase's (1937) seminal work to address this question. The argument offered is that as the firm gets larger, it becomes less effective in organizing its production, i.e. diseconomies of scale emerge. To understand the concept of diseconomies of scale, we can take a look at the benefits of contracting. As presented in Table 2-1, Domberger's (1998: 50) own research identifies four major categories of these benefits. The first three categories can be turned to the cost factors of insourcing.

First, insourcing limits the level of resources that a company can invest in its core activities. These resources include both managerial and financial capital. Second, in an integrated environment the activity performed in-house does not face direct competition

as in the case of an independent company. This removes the possibility to shop for the best partner and costs are caused by actions to spur development and innovation. Third, the loss of flexibility due to the vertical integration means higher costs in adapting to a changing environment.

The fourth benefit, cost savings, incorporates the first three categories of benefits. Domberger (1998: 51) claims that outsourcing usually creates cost savings, but as this is not applicable to all cases it cannot be universally claimed that outsourcing decreases the total of transaction costs. As a result, this study relies on the assumption that cost savings can be acquired by minimizing total transaction costs, whether it means insourcing or outsourcing.

Table 2-1 A summary of the benefits of contracting (Domberger, 1998: 51)

Title	Definition	Assessment
Specialization	Concentrating on those activities in which the organization has established a distinctive capability, letting others produce supporting goods and services.	Specialization yields demonstrable economic benefits. By concentrating on activities in which an organization is *relatively* more efficient, total value added is maximized. It also facilitates the exploitation of scale economies.
Market discipline	Identifies conditions in which the purchaser is separated from the provider and a formal transaction takes place under contract.	Market discipline provides a range of benefits, namely, focus by the purchaser on outputs not inputs, competition (contestability) between suppliers, choices by purchasers, and innovative work practices.
Flexibility	The ability to adjust the scale and scope of production upwards or downwards at low cost and rapid rate.	Networks of small organizations linked to their clients via contract can adjust more quickly and at lower cost to changing demand conditions compared to integrated organizations.
Cost savings	Lower resource costs of service delivery compared to in-house production.	International studies show that significant cost savings are achieved by contracting, on average of the order of 20%. As a rule efficiency gains need not lead to lower quality.

The discussion above takes us to the question: how does the minimization of transactional costs show in the boundaries of actual companies? This question is addressed in the following subchapter which summarizes the views of selected studies that review empirical work on transaction cost economics.

2.2.2 EMPIRICAL EVIDENCE

The amount of empirical work on transaction cost economics is immense. Accordingly, Oliver Williamson does not hesitate in declaring the theory to be an empirical success story in several publications (e.g. Williamson, 1998: 40). As he notes, literally hundreds of empirical studies are available (Williamson, 1998: 39). Surveys consolidating the empirical work provide valuable information on how successful transaction cost theory has been in explaining organizational boundaries. Such reviews are available, for example, by Joskow (1988), Shelanski & Klein (1995), Klein (2005), David & Han (2004), Richman & Macher (2006) and Carter & Hodgson (2006). Findings of the latest surveys are discussed below.

Richman and Macher (2006) survey a recently published selection of significant contributions in the empirical work on transaction cost economics. The general emphasis is on the fact that empirical studies offer considerable support for the basic transaction cost framework. Success has been significant in finding the correlation between high asset specificity and tendency to integrate vertically (Richman & Macher, 2006: 49). David and Han (2004) have much more reserved support for the success of transaction cost theory in their quantitative analysis of 308 statistical tests in 63 articles. They see that the theory lacks support in its other aspects than the correlation between vertical integration and asset specificity (David & Han, 2004: 48). Several surveys of empirical literature see limitations also in determining uncertainty. The definition of uncertainty ranges widely from behavioural uncertainty, such as opportunism, to environmental uncertainty (e.g. Richman & Macher, 2006: 52-54, Carter & Hodgson, 2006: 467). David and Han (2004: 52) even illustrate that there are almost as much studies showing negative correlation between uncertainty and vertical integration as there are studies showing positive correlation. Both, David & Han (2004: 52-53) and Richman & Macher (2006: 53), find it troubling that the studies do not compare the performance of organizations that rely on "make" or "buy" strategies in similar settings of uncertainty and asset specificity. In addition to performance, David and Han (2004: 52) point out that the frequency of transactions has not received much scrutiny.

To summarize the empirical observations of transaction cost theory, we can say that the link between asset specificity and vertical integration is well established. In contrast, uncertainty has been understood in several different ways and its link to organizational boundaries is still unclear. In addition to asset specificity and uncertainty, the third

variable, frequency, has received limited attention and is not therefore particularly supported as a cause of vertical integration. Finally, it is important to note that empirical evidence does not yet prove that aligning the organizational structure according to asset specificity, uncertainty and transaction frequency produces gains in company performance.

The above mentioned limitations suggest a conservative view in linking transaction costs to the level of vertical integration. For that reason, this study is not based on the assumption that the three specific variables of asset specificity, uncertainty and transaction frequency determine the optimal contractual boundaries. Instead, it is aggregately viewed that increasing transaction costs of contracting shift the optimal strategy from operating on markets to organizational integration. Williamson (1998: 39) summarizes the logic of determining the organizational form: "Try markets, try hybrids, and have recourse to the firm when all else fails." This is depicted in Figure 2-2.

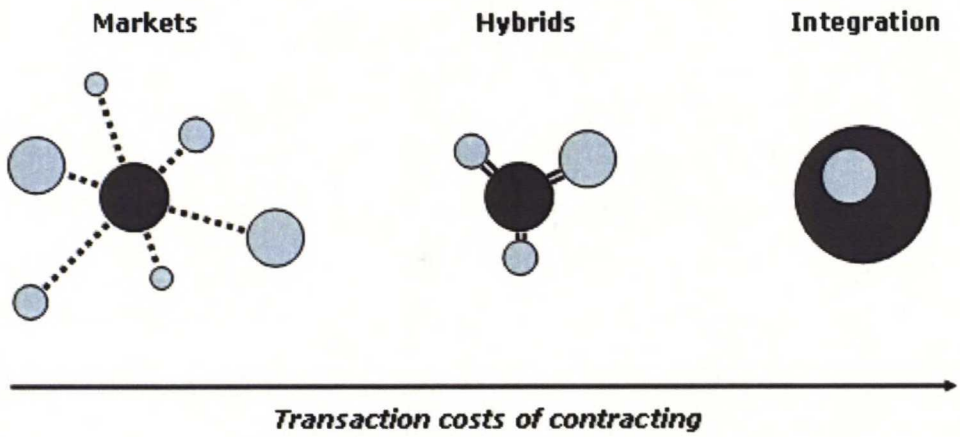

Figure 2-2 The effect of transaction costs on organizational forms

Klein (2005: 456) concludes in his survey of empirical literature that the number of publications on hybrids has grown dramatically during the last ten years. The following chapter focuses on that literature and reviews the hybrid strategies that have received attention.

2.3 HYBRID ORGANIZATIONS

Dubois (1998: 12) explains that in the early literature by Williamson (e.g. 1975) the choice of the governance mode between two actions could be determined only as "markets" or "hierarchy". However, Williamson's later literature incorporates the view of an intermediate mode of governance, the hybrids. Regarding the case of vertical

relationships, hybrid modes of governance include contractual relationships that create a deeper relationship between the buyer and seller than spot contracts as well as investments into joint projects or equity outside the company boundaries. In transaction cost economics the hybrids are viewed as a blend of both markets and hierarchy. Thus they are presumed to be employed when the variables of asset specificity, uncertainty and frequency are not all in line to support either spot markets or internal organization. Klein (2005: 445) notes that such situation could arise, for example, when asset specificity is substantial, but only minor uncertainty is present. In such a case, long-term contracts may be used to mitigate the risks of opportunism successfully.

Carter and Hodgson (2006: 473) conclude in their survey of empirical literature on transaction cost theory that Williamson's work in general does not provide sufficient details about the characteristics of hybrid organizations. Consequently, their observations show that relatively few of the studies on hybrids support the ability of transaction cost theory to explain the selected modes of governance. However, Allen and Lueck (2005: 486) remind that the empirical work on agency theory shows that the transaction cost theory should not be abandoned for a simple explanation such as the classic trade-off between risk and incentives. In this research we take note of the shortcomings in transaction cost theory and join the view of Bello et al. (1997) that the theory does not alone explain the large number of hybrid strategies used today. Production costs and strategic considerations have also a significant impact in the selection of the strategy (Bello et al., 1997: 130). The following subchapter reviews the modes of governance that are existent in business practice.

2.3.1 DETERMINING THE TYPE OF INTERFIRM RELATIONSHIPS

The number of specific modes of governance under the topic of hybrid organizations is immense. In addition, the absence of a widely used analysis framework has lead to the creation of a colourful array of studies. An examination of several publications (Carter & Hodgson, 2006; Fan, 2000; Heriot & Kulkarni, 2001; Klein, 2005; Ménard, 2004; Peterson et al., 2001; Powell, 1987; and Richman & Macher, 2006) helps to identify a number of variables that are commonly used to distinguish different modes of organization from each other. It is notable that many of the governance modes presented are studied only from either vertical or horizontal integration point of view. The repeatedly used variables include the duration of the relationship (e.g. medium-term contracts versus long-term alliances), investments to improve the relationship or in

common equity (e.g. contractual safeguards and joint-ventures), number of players considered (e.g. bilateral relationships versus networks of multiple companies) and contractual modes (e.g. informal agreements versus written contracts).

The duration variable deserves a specific note. Ménard (2004: 348) emphasizes that in some cases contracts can be short-term, but relationships durable. This can be the case when the contract is specified for a single project only, for example in building industry or consulting. In construction industry, the same subcontractor may have supplied the builders for years even if there were no formal long-term contracts. Consequently, measurement of relationships' durations and their relation to transaction costs is difficult as contract duration does not provide a clear indicator about the duration of a relationship. To categorize different modes of governance we focus on the other variables and consider duration as a variable that creates modes of operation inside a category.

Investments that are related to a hybrid strategy provide a natural way to link different hybrid strategies to transaction costs. Measuring the type of investments made to support the relationship provides also some indication on whether the relationship is expected to be long-term or short-term. In joint-ventures the relationship is likely of a durable type, whereas in the case of short-term relationships large investments are less likely to occur. Similar reasoning can be used to contractual modes. In usual business transactions a written contract is a common way to bind the companies together when the relationship is prolonged to last for an extended period. Of course, exceptions to this can be observed. Klein (2005: 449) notes that in some cases the use of written contracts has been prohibited or the high value of the relationship to the both parties has justified informal contracting.

The number of players that form a network with their relationships to each other is a variable that can be employed in different ways. Either the whole network can be viewed as a hybrid mode of governance or the bilateral relationships that compose the network can be analysed as separate strategies. Klein (2005: 449) discusses the empirical literature on networks and identifies that network's are built by agreements, both written contracts and informal, between the individual players. To be consistent in the use of this variable, we do not consider networks of firms as a mode of governance but more as a result of selected types of organization in bilateral relationships. When many of the operations in a product's value chain are carried out by contractors, the

formation of a network takes place. Subsequently, the type of bilateral relationships inside the network defines how closely the players work towards increasing the profitability of the entire chain.

Peterson et al. (2001: 152) see investments as a tool to intensify the decision making power in a vertical relationship. The objective of their study is to create a decision tree - type framework for agricultural managers to choose the optimal strategies for interaction with other companies. The performance of the framework is more deeply reviewed in their further study (Wysocki et al., 2003). While the framework presented does not provide many refined tools to help to measure the costliness of a mode of governance, the research provides a solid division of the different modes. This division is presented in Figure 2-3. Between spot markets and full vertical integration there exist specification contracts (from structured short-term contracts to longer contracts), relation-based alliances (from collaborative planning to investments that enhance the joint performance) and equity-based alliances (from joint-ventures to partial ownership of the partner). These categories are discussed and slightly modified in the following subchapter.

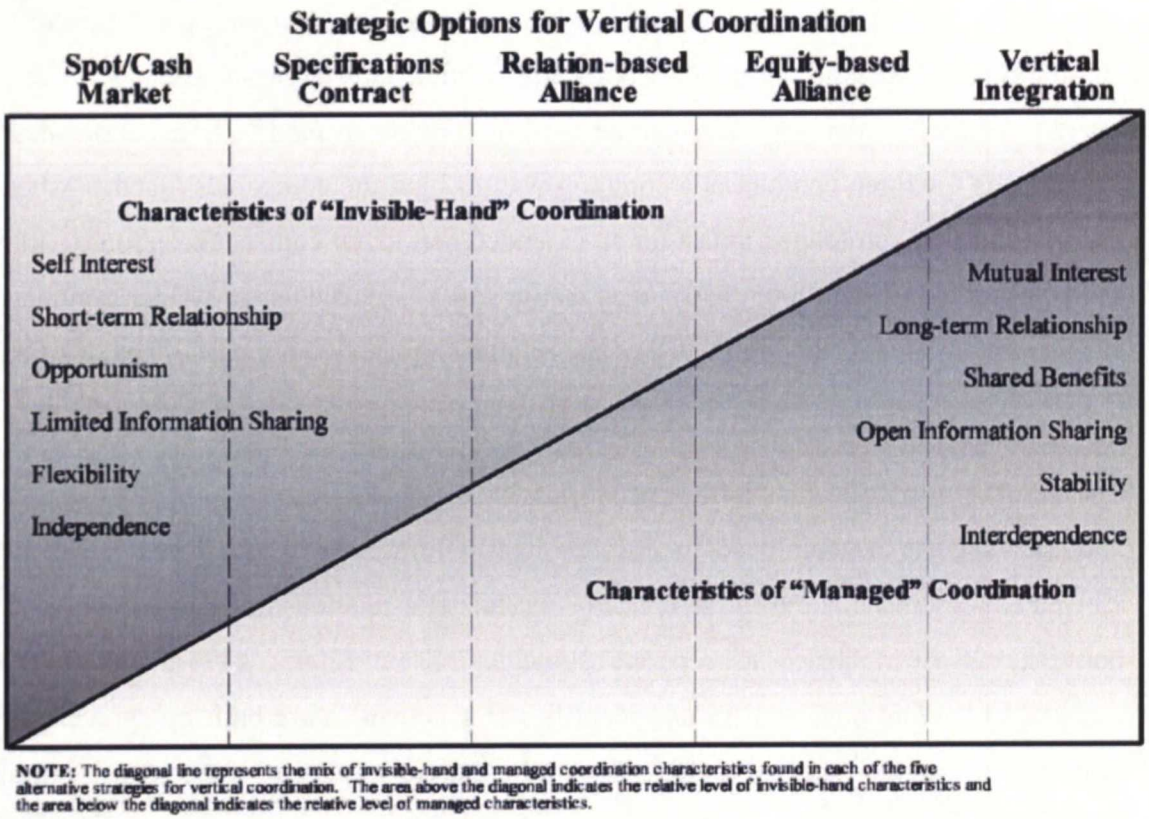

Figure 2-3 The vertical coordination continuum (Peterson et al., 2001: 151)

2.3.2 INTERMEDIATE MODES OF GOVERNANCE

The strategic options pictured above by Peterson et al. (2001) are not fully compatible with the basic view of transaction cost economics. Peterson et al. (2001: 152) regard spot markets to facilitate only simple and immediate exchange of goods to cash whereas the literature on transaction cost theory does not usually limit the possibility to also use written and detailed contracts in spot deals. In Peterson et al (2001) the written forms do not come to play until in specifications contracting. In addition, the definition of specifications contracts allows also spot contracts to be included since the contracts can be written for single or multiple transactions. The other end of the continuum requires also some scrutiny to be used in parallel with transaction cost theory. The definition of vertical integration by Peterson et al. (2001: 156) does not rule out the possibility of multiple owners of the organization. Vertical integration is viewed mostly as a mode of governance whereas the actual ownership can vary. Furthermore, it also means that single ownership does not necessarily mean vertical integration. From the transaction cost economics view, using hierarchy as the mode of governance is usually understood as simply as a company producing its own inputs.

Due to these differences, the categories of governance modes are defined in this study in a slightly different manner while preserving many characteristics of the classification by Peterson et al. (2001). The modes of organization are divided to spot contracts, contractual relationships, partnerships, equity-based alliances and full vertical integration. The characteristics of each category are summarized below.

Spot contracts

Spot contracts are usually created to govern a single transaction that takes place directly or shortly after the terms and conditions have been agreed on. In its simplest form the deal can be a plain exchange on predefined terms. In such a case an informal agreement instead of a written contract can be sufficient. On the other hand, a spot deal can also necessitate a considerable amount of effort in screening the contract partners, negotiating and coordinating the transaction. Disputes between the contracting parties are typically resolved by the governance of a third party, e.g. arbitration or court proceedings.

Contractual relationships

Contractual relationships can be created and maintained by writing medium to long-term contracts that cover a series of transactions. If the properties of the exchange vary significantly between transactions, the contracting organizations may choose to write a distinct contract for each transaction. In that event the contractual relationship constitutes of a series of spot contracts. However, the major difference to the category of spot contracts is that the parties do not exercise similar partner selection process prior to the agreement. A series of differing contracts can be tied together with a frame contract that defines the basic terms for transactions and binds the contracting sides together. Disagreements between the contracting parties are ultimately enforced by a third party, i.e. the legal system. However, the contract partners have also incentive to solve problems internally because they have their bilateral relationship at stake. In literature contractual relationships are usually referred to as long-term contracts (e.g. Klein, 2005: 445).

Partnerships

Partnerships are created when organizations deepen their contractual relationships by initiating cooperation where the benefits and risks are shared between both parties. The companies still remain as separate entities from the ownership perspective. Successful partnerships require resources and commitment from both companies. In that sense, building and retaining the partnership requires continuous support that goes beyond the terms written on a contract. Consequently, the contract behind the relationship works as a fallback mode of governance in case the cooperation does not acquire the support it needs. If the cooperation involves investments, they can act as safeguards and incentives that bind the companies more tightly together. In that case the companies have increased incentive to solve disputes without recourse to third party jurisdiction.

Partnerships take various names depending on the type of cooperation. Involvement of multiple firms creates networks or clusters whereas the term alliance can cover also the basic bilateral partnership. Special cases of partnerships include also franchising and licensing arrangements if the licensor and the licensee are not linked through equity. The investments in the partnership can be reciprocal or the whole relationship can be based on reciprocal trading. On the whole, partnerships can be described as long-term cooperative relationships with credible commitment (Heriot & Kulkarni, 2001: 19).

Weele (2005: 165) sheds light on the objectives of partnerships. Cooperation usually targets to improve logistics, increase end product quality or facilitate product development. One approach to improve logistics is to share production and material schedules which can lead to more accurate projections of requirements. Quality can be enhanced by "zero defects" policies and joint development of processes. Cooperation already from the early phases in product development can result in shorter time-to-market for new products as well as reductions in start-up and production costs. Creating and maintaining a working partnership generates costs, but investments in joint equity take the relationship to the next category of equity-based alliances.

Equity-based alliances

Investments in joint equity are a possible way to intensify the coordination between two companies. Equity based alliances can be formed through direct investments to partner's equity or to a co-owned entity, i.e. joint-venture. In partnerships of the previous category the power to govern the cooperation is divided fairly equally between both companies as they both have the option to walk away from the cooperation. The joint ownership structure in equity-based alliances changes the picture. The governance of the partnership is affected by ownership relations as they define the ultimate power of decision in a company. Consequently, by buying a share of its partner a company can gain control of the relationship.

If the selected mode of cooperation is a joint-venture, the control is affected heavily by the percentages of ownership. Peterson et al. (2001: 155) point out that through ownership the control can be accomplished organizationally, but it remains still decentralized as the parties do not have a full control over each other. Partly joint decision making creates incentives to avoid third party jurisdiction if disputes arise. The cost of walking away from the contract is high for both parties as it may require, for instance, restructuring share holdings. On the other hand, if one party has the majority voting right over the other party through ownership, the situation is even more strongly influenced by hierarchical control. Finally, as the companies still remain legally separate entities in equity-based alliances, the possibility of third party jurisdiction is not ruled out in case negotiations fail.

Full vertical integration

Full vertical integration can be achieved by insourcing the operation that could be carried out by a contractual partner. Such insourcing can be done by acquiring the business from another company, merging whole companies or committing internal resources to establishing new operations (Peterson et al., 2001: 155). The result is centralized control over the resources used and actions performed. Consequently, full ownership centralizes the final decision making power to the hands of a centralized management removing the possibility of appealing to third party jurisdiction if problems arise in internal negotiations. Full vertical integration does not necessarily mean that the company would not every now and then use markets for transactions as well. Heriot & Kulkarni (2001: 19) refer to the parallel use of own production and markets as taper integration.

The modes of hybrid governance can be examined from the perspective of transaction cost economics. The following subchapter discusses the framework of Ménard (2004) that visualizes hybrids on the transaction cost continuum.

2.3.3 TRANSACTION COST PERSPECTIVE

Pointing out the positions of different modes of hybrid organization between "markets" and "hierarchies" is difficult. The literature reviewed for this study shows that a unified view about the issue is yet to be widely accepted. In fact, even the names and categories of hybrid modes of governance vary significantly from one study to another. One of the few attempts to create a transaction cost framework of hybrid organizations is by Ménard (2004). He finds four distinct categories of hybrids between the pure "make" and "buy" strategies: trust, relational network, leadership and formal government. The names of the categories represent the governing force that makes the strategies in that category more complex than the plain spot transaction, but less structured than the pure full integration. The positioning of the categories is presented in Figure 2-4 which has asset specificity on the horizontal axle and transaction costs of each mode on the vertical axle.

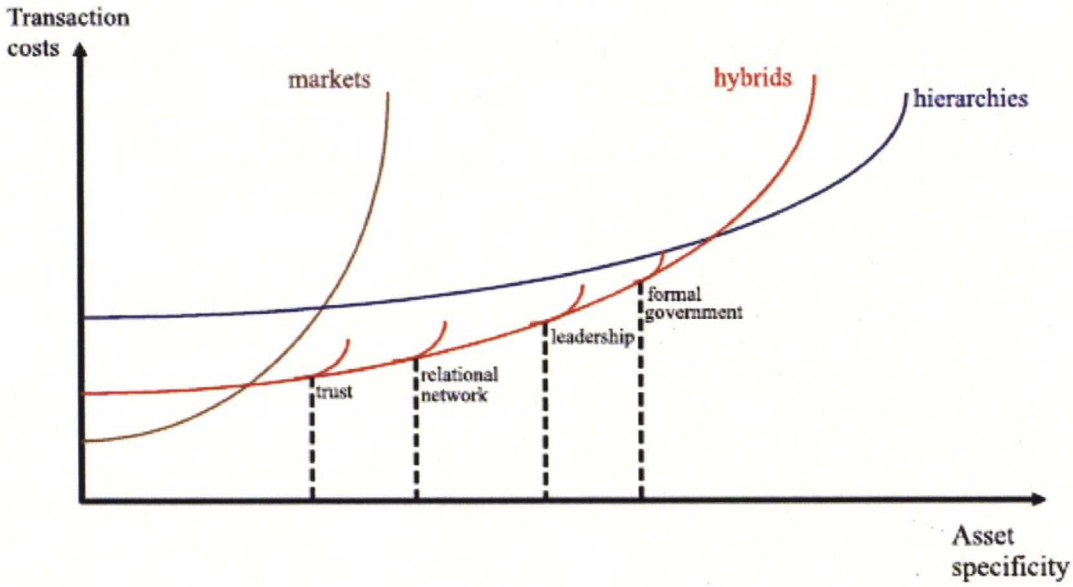

Figure 2-4 A typology of hybrid organizations (adapted from Williamson (1991) by Ménard, 2004: 369)

Ménard (2004: 367) describes the different categories of hybrid organizations by observing the mode of coordination in the relationship. *Trust* means that the power to govern the contract is enhanced from the level of the contract by mutual influence and reciprocity. The incentives to negotiate instead of relying on third party settlement of disputes are created by the willingness to maintain the relationship. *Relational networks* have a tighter coordination than trust-based relationships. They have established procedures of solving problems in cooperation in the form of rules and conventions. *Leadership* is a mode of governance where the network of transacting partners is governed by the party that has the key position. This can be typical, for example, in car manufacturing where the whole production chain is controlled by the car manufacturer itself. *Formal government* is the mode of governance that is closest to the integrated company. This is the case for example in joint-ventures where the cooperative company exercises its own hierarchy to an extent.

If we compare the definitions of these categories with the ones presented in the previous subchapter, it can be noted that they are organized in a rather similar manner. Trust shares elements with contractual relationships and partnerships, relational networks present comparable governance structures to partnerships and also partly to equity-based alliances. Leadership and formal government are clearly modes of organization in equity-based alliances. This comparison is presented visually in Figure 2-5.

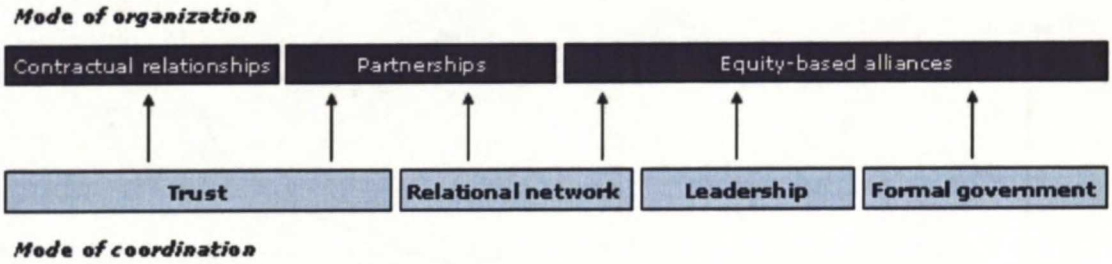

Figure 2-5 Modes of organization and coordination in hybrid organizations

Ménard (2004: 368) argues that the mode of coordination moves from trust to formal government when asset specificity increases. If this proposition holds, we can link this to the conclusion of Chapter 2.2.2 that transaction costs of contracting increase when asset specificity increases. As a consequence, it could be proposed that the modes of organization and coordination as presented in Figure 2-5 can be similarly set on the continuum of the transaction costs of contracting. This proposition is crafted into a framework in the following chapter by incorporating characteristics from evolving commodity markets.

3 EVALUATING SOURCING STRATEGIES

Many types of vertical relationships are used in business practice, but only little guidance is available for managers who are in the process of selecting a specific sourcing strategy. The transaction cost theory alone is not able to guide managers to create optimal inter-company relationships and requires support from industry and company specific analyses. This study sets off from the transaction cost perspective (Chapter 3.1) and then studies the attributes of evolving commodity markets to create a framework that points directions for managers considering different future outcomes and optimal organizational forms (Chapter 3.2). In building the framework the nature of an evolving commodity market is derived from the global vegetable oil markets.

Vegetable oil markets have faced major changes in the recent past. The markets were controlled by food industry for decades as other industries covered only a very small part of the total demand. At the turn of the millennium, biofuel industry started to gather speed and began to compete seriously for the same raw-materials as the food industry. In addition to the competition between these industries, the use of vegetable oils in food processing faces intense growth. Large developing nations, such as China and India, grow in terms of population, but also in the use of vegetable oils per capita. The latter is caused by the fact that the consumer habits in these countries become all the time more similar to developed countries. As a consequence of the changes, vegetable oil markets evolve rapidly to the direction of increased competition and growth pressures on the supply side. The characteristics of the markets are pictured in this chapter at a general level and then studied more closely in the following case study (Chapter 4).

The framework presented in this chapter is projected to be applicable for business to business commodity markets that face major changes and growth. As the basis is derived from a single industry, further research is required to test the applicability of the model in other markets. In its current form, the framework has limited applicability in service markets and in industries where demand or supply is dominated by few players, but the contracting side is represented by a large number of players. The latter limitation is derived from the fact that in global vegetable oil markets the number and market power of both supplying and sourcing players are fairly equal. In addition, it is expected throughout this framework that the sourced commodities are required continuously and thus the frequency of transactions is at least on a medium level.

3.1 USING TRANSACTION COST THEORY

To review the applicability of using transaction cost theory in evaluating different sourcing strategies we can refer to Chapter 2.3.2 which specified what lies between the simple "make" and "buy" strategies. It was noted that the intermediate modes of organization can be divided into contractual relationships, partnerships and equity-based alliances. Chapter 2.3.3 then discussed the connection of these modes with Ménard's (2004) framework and proposed that the modes of organization can be similarly set on a continuum that correlates with transaction costs. Figure 2-4 (Ménard, 2004: 369) in the previous chapter illustrated that the optimal strategy in terms of total transaction costs changes as asset specificity increases. By relying on the connection between asset specificity and transaction costs of contracting, the ideal sourcing strategy in terms of total transaction costs could be found by estimating the transaction costs of contracting. This estimation requires assessing uncertainty, asset specificity and the frequency of transactions in a relationship.

The concept of increasing intensity of coordination is pictured in Figure 3-1. Movement to the right on the horizontal axle represent an increase in transaction costs of contracting and consequently increases the coordination power required. In spot agreements the coordination is based fully on contracts whereas in equity-based alliances the coordination is based on contracts, trust, relational network and leadership. The last mode of coordination may also be supported by formal government. In full vertical integration the governance is in the hands of an internal organization.

The limitations of using transaction cost theory in evaluating strategies come from the fact that universal methods to measure asset specificity, uncertainty and frequency do not exist. Instead of providing means to optimise organizational structures, transaction cost economics works more as an explanatory theory that describes why companies have selected their specific mode of organization. As a consequence, testing the proposed linkage between the transaction costs of contracting and the optimal mode of hybrid governance is very difficult.

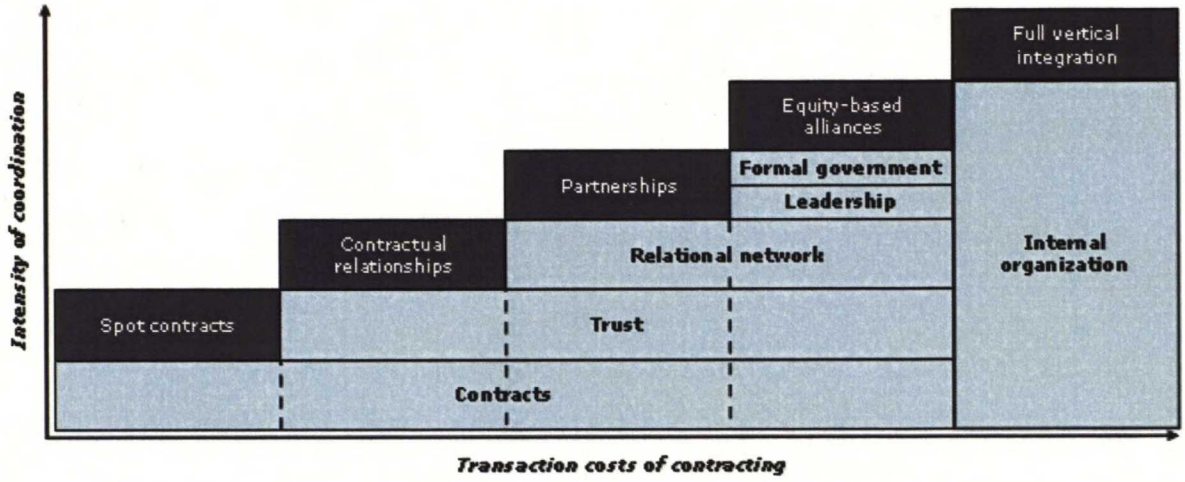

Figure 3-1 The optimal modes of organization in vertical relationships

As company performance is affected more by evaluating different sourcing strategies prior to decision making than explaining the selections afterwards, the variables behind the transaction costs of contracting have to be presented in a measurable manner. Chapter 3.2 integrates the main attributes of evolving commodity markets into these variables to form a framework that can be used to evaluate different sourcing strategies.

3.2 APPLICATION IN EVOLVING COMMODITY MARKETS

Chapter 3.2.1 portraits the attributes of evolving commodity markets and is followed by a framework in Chapter 3.2.2. The framework is created by combining the transaction cost approach to the actual characteristics of the markets in scope and the companies operating in them.

3.2.1 MARKET CHARACTERISTICS

The characteristics of evolving commodity markets are created by the business environment and the selling and buying organizations. These three parties can be viewed through the variables that have an important impact on the success of different sourcing strategies. The variables are summarized in Figure 3-2.

The business environment includes the governmental regulations and other incentives that affect the production and consumption of a commodity. In vegetable oil markets such regulation is visible, for instance, in mandates to cover a specific percentage of transportation fuels by biofuels. In addition to this example, incentives to increase the consumption beyond the level supported by regulation may come from other markets, e.g. crude oil markets. If the price of crude oil is high compared to vegetable oils, an

additional incentive to produce vegetable oil based biofuels is created. Another important variable is the current business cycle that affects, for example, the propensity to invest in technological development and the growth of demand and supply.

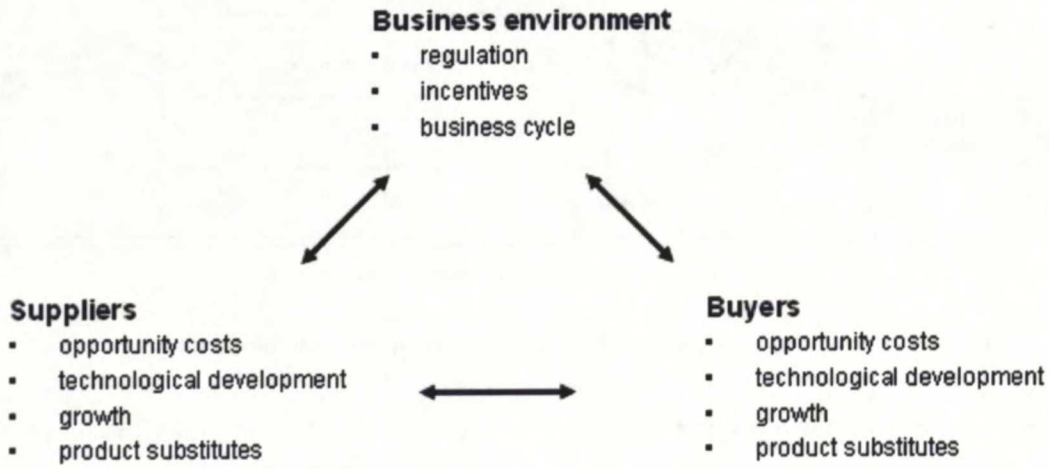

Figure 3-2 Evolving commodity markets

The supplying organizations in evolving commodity markets are affected by the opportunity costs of using their production inputs. For instance, in vegetable oil markets the suppliers have the choice of using the land they possess for the cultivation of different oil crops or other crops. Suppliers are also affected by the development in research in several ways. They can benefit from the research by finding methods to increase production and to reduce production costs. On the other hand, the development may bring substitutes to their products that limit the demand. For example, current vegetable oil producers face the fear of a market entry by alternative renewable oils such as oil from industrially produced algae. The products that the suppliers offer are often substitutes to each other but rarely fully similar. As an example, some vegetable oils are better for specific uses than the others. Finally, the general growth of the supply determines largely how the markets work in the future.

The sourcing organization is affected by a similar set of variables as the supplying organization. They have first faced the opportunity cost when they entered the market by building processing capacity that requires the specific commodity as an input. In the actual markets the opportunity costs arise from the choice of whether to process the commodity or to sell it to the markets. An example of this can be seen in the vegetable oil markets as well. The rising prices have made it more attractive for a number of European biodiesel producers to sell the vegetable oils they had purchased on firm prices back to the market, keep the own production suspended, and fulfil the sales

commitments by purchasing spot cargoes of biodiesel from USA. It should also be noted that in some cases opportunity costs arise if the production capacity can be altered to process also totally different raw-materials. The actual end-products have substitutes as well. For example, in geographical areas where the use of biofuels is not supported by regulation, traditional diesel is the main alternative for biomass based diesel fuels. Technological development may also open new possibilities in the raw-materials and processing. The markets can be affected in many ways as the development can result in increased reliance on a single raw-material to produce better end-products or increased flexibility to use a wider array of raw-materials. In addition to development, the simple growth in the demand of a commodity has its own impact on the market dynamics.

3.2.2 THE FRAMEWORK

The characteristics of evolving commodity markets presented above determine the asset specificity and uncertainty the sourcing company faces. While these two variables are hard to measure, they can be split into scenario-like settings that can be used to evaluate possible strategies. As it was pointed out earlier, in this study the sourcing of commodities is expected to be continuous and thus the frequency of transactions to remain medium or high.

Table 3-1 contains the scenarios resulting from taking a market specific approach to asset specificity and uncertainty. It is intended to be used as a tool to align sourcing strategies with the future expectations when operating in evolving commodity markets. To keep the tool fairly simple, both the markets and the sourcing company are divided into two variables, i.e. alternative opportunities and future development. This simplification leaves out many of the details that actually cause the specific scenarios. For instance, a threat of sudden changes in supply can result from a legislative change that supports the production of competing raw-materials. This type of events can be seen in the European vegetable oil markets where the policies of European Union have a large impact on local agricultural production. As a consequence, to efficiently use the aggregate variables in selecting a sourcing strategy, background work has to be carried out on the impacts of expected market evolvements.

The suggested manner to use the framework is to first analyse the markets in scope and the sourcing company to establish a picture on how they operate and where they are heading. When the picture is created, the second step is to apply this knowledge into

practice with the help of the framework. The probable scenarios should be selected by going through each of the rows containing the scenarios and selecting the ones that best represent the current, projected or desired status of the markets and the sourcing company. When scenarios have been selected from each of the four rows, their alignment compared to different strategies on the topic row can be examined.

This type of a tool has major limitations. It only points out sourcing strategies that can provide assistance to the main strategic considerations, but does not address the question of whether a strategy would be financially optimal. This type of limitation arises, for example, when a small company finds support for full vertical integration from the scenarios, but financing the integration would ruin the economics of the company. It is thus vital to see the difference between the strategic consideration and the financial analysis. As a consequence, this framework can be only used as support in decision making.

To investigate the applicability of this framework in actual evolving markets, the case study in the following chapter analyses raw-material sourcing of Neste Oil in vegetable oil markets. The case study digs deep into the biofuel strategy of Neste Oil and analyses three sourcing strategy possibilities in different scenarios.

Table 3-1 Strategy evaluation framework for sourcing commodities in evolving markets

	Spot contracts	Contractual relationships	Partnerships	Equity-based alliances	Full vertical integration
Markets Alternative opportunities of suppliers	Very low incentives or possibilities for suppliers to produce alternative commodities or to seek new markets	Suppliers are not expected to make any drastic changes to their production of the commodity	Threat of opportunistic behaviour; long-term continuity cannot be secured by mere contracting	Incentives of suppliers and buyers are misaligned; cooperation cannot be used to realign the incentives	Suppliers are likely to optimize the return on their assets continuously; threat of sudden changes in the supply
Future development	Substitute commodities and alternative suppliers are bound to enter the market in near term; aggressive growth of availability	The supply of the commodity meets the demand; the status quo is expected to continue	The commodity is generally available; suppliers are willing to seek higher value by cooperation with buyers	Threat of availability problems; suppliers have only little incentive to invest in cooperation	Major structural changes in the market expected to take place and reduce the availability of the commodity significantly
Sourcing company Alternative opportunities	Constant incentives and possibilities to direct the purchased commodity and other resources to alternative uses	Medium to long-term flexibility in the use of assets creates valuable business opportunities	Changes to the use of resources difficult; specific raw-material requirements	Both the raw-materials and the production assets are specific to the current production for long periods of time	Very specific assets that cannot be taken to other applications
Future development	Changing raw-material requirements; end-product demand varies considerably	Generic raw-material requirements; strive for a stabile supply chain	End-product value can be enhanced by cooperation with suppliers	Strong control of the raw-material supply is required to secure end-product value	Substantial need for a specific raw-material; the attributes of raw-material are critical for end-product success

4 CASE NESTE OIL

This case study examines possible raw-material sourcing strategies of Neste Oil in vegetable oil markets. The objective is to find out whether a thorough strategic analysis would lead to similar suggestions as the framework presented in the previous chapter.

This chapter is divided into six subchapters. First, Chapter 4.1 briefly presents the case company, Neste Oil, and then outlines its objectives in raw-material purchasing. Three different strategies are selected for further analysis. Chapter 4.2 presents three business environment variables that are used in scenario analysis of the selected strategies. Chapter 4.3 discusses the strategy of sourcing palm oil with contractual relationships, Chapter 4.4 considers full vertical integration up the level of palm oil cultivation, and Chapter 4.5 considers a combination of full vertical integration to soybean crushing and also briefly partnerships in the sales of crushing side-products. Finally, Chapter 4.6 concludes the analysis with suggestions to the case company in different future scenarios and compares the findings to the framework presented in the previous chapter.

4.1 BASIS FOR THE STRATEGY ANALYSIS

Neste Oil is a Finnish oil refining and marketing company. Its focus and core competencies are in the production of high quality fuels for cleaner traffic from a variety of low-cost raw materials. The production is carried out mainly in Finland at two refineries, Porvoo and Naantali. Neste Oil is also an owner in several join-venture based refineries. Petroleum products are both marketed in Finland (2006: 8,1 million tonnes) as well as exported to international markets (2006: 6,0 million tonnes) (Neste Oil, 2007). The retailing network of Neste Oil covers over thousand service stations in Finland, Baltic states, Russia and Poland. Neste Oil is one of the largest companies in Finland with over 4700 employees and a turnover of 12 billion euros in 2006 (Neste Oil, 2007).

4.1.1 NEXBTL RENEWABLE DIESEL

The current strategy is based on growth in the traditional mineral oil refining and biomass based diesel production. These functions are supported by the company's own tanker fleet, the retailing network and specialty products division. The biomass based diesel is produced with Neste Oil's own patented technology, NExBTL. The end

product differs significantly from the traditional biodiesel (Fatty Acid Methyl Ester, FAME) that is produced in a transesterification process of fats and oils. Instead of esters, the NExBTL process produces diesel-like hydrocarbons. Due to this difference, this study does not refer to NExBTL as biodiesel, but as renewable diesel or synthetic diesel.

Neste Oil produces renewable diesel currently at the Porvoo refinery in a plant that has 170 000 tonnes of annual capacity. The company has announced that it is building another similarly sized production line in Porvoo and negotiates with the Austrian company OMV on a joint-venture production unit in Austria (Neste Oil, 2007). However, to achieve the status of the leading biomass based diesel producer, the number of the production units is to be increased substantially. Neste Oil aims to have over 2 million tonnes of NExBTL production capacity operational by the year 2012.

NExBTL can be produced from a wide variety of raw-materials including vegetable oils and animal fats. To avoid the competition on vegetable oils with the food industry, Neste Oil develops alternative sources of feedstock such as oil from forestry side-products and industrially grown algae. These non-food feedstocks are projected to be available in large scale near the year 2015. Consequently, Neste Oil has to supply its production units with currently available raw-materials during the upcoming years. The critical transition period of high raw-material demand and low availability of non-food feedstock is approximated to be 2010-2015.

4.1.2 RAW-MATERIAL PURCHASING

The raw-materials available in large scale during 2010-2015 are vegetable oils and animal fats. However, animal fat supplies are scattered to a large number of small players and the total volumes are significantly lower than the vegetable oil volumes. The total global volume of animal fats produced in 2005 was 8 million tonnes whereas the production of vegetable oils reached 120 million tonnes (FAOSTAT, 2007). As a consequence, it is seen that the majority of the raw-material demand has to be satisfied with vegetable oils.

The supply chains of different vegetable oils that are used for biofuels production follow the general pattern presented in Figure 4-1. This illustration of a supply chain excludes the operations prior to the plantation. These operations include seed development and in the case of oil palms, the nursery that is used to grow the seedlings

before planting them to the actual plantation. Several operations in the supply chain may be carried out at the same physical facility. The practice in this differs between vegetable oils because of the different market characteristics and operational constraints.

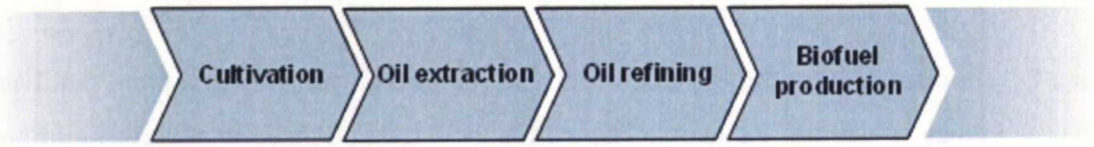

Figure 4-1 The supply chain of vegetable oils

Table 4-1 summarizes the global production volumes of the most produced vegetable oils. This study concentrates on the purchasing of the two largest vegetable oils, palm oil and soybean oil. In Europe, rapeseed oil is currently the dominant raw-material in biodiesel production. However, it is used mainly due to processing constraints in transesterification and continues to remain more expensive than palm oil and soybean oil. NExBTL process has less feedstock constraints than the traditional biodiesel producers and focus on the two less expensive alternatives is justified. Further insight into the production processes and different product grades of palm oil and soybean oil is provided in the appendices of this study. Appendix 1 explains the attributes of palm oil and Appendix 2 focuses on soybean oil.

Table 4-1 Global production volumes of the major vegetable oils in 2005 (FAOSTAT, 2007)

	million tonnes / a
Palm oil	34,3
Soybean oil	33,7
Rapeseed oil	16,2
Sunflower oil	9,7
Groundnut oil	5,1
Cottonseed oil	4,9
Palm kernel oil	4,0
Coconut (copra) oil	3,3
Olive oil, virgin	2,5

The aim in the raw-material purchasing at Neste Oil is to secure availability in the long term, benefit from feedstock flexibility by choosing the least expensive raw-materials and ensure that the raw-materials are produced in a sustainable and environmentally healthy manner.

Securing the availability has become a major concern. Vegetable oil based biofuel production soars and at the same time the demand for food use increases rapidly due to the growth of world population and changing consumer habits in developing countries. This has driven the prices of all vegetable oils up as well as led to pressures to increase the supply. The supply can be increased by improving yields or expanding the cultivated area. The increased use of genetically modified crops, fresh water irrigation, pesticides, herbicides, fertilizers and mechanisation in cultivation has stirred public concern about the environment. In addition, the increase of cultivated area from untouched forestlands threatens biodiversity and existence of aboriginal tribes. To maintain the green image of the company, Neste Oil wants to ensure that its purchasing is carried out in an environmentally sound manner.

4.1.3 SELECTING THE STRATEGIES IN SCOPE

Palm oil is a product that can be viewed in two very different ways. Referring to the purchasing portfolio approach introduced in Chapter 2.1.1, it can be categorised as a leverage product or, on the other hand, a strategic product. In general, palm oil is widely available and as all the producers offer nearly identical products, substituting a supplier with another is not complicated. These are typical attributes for leverage products. Conversely, the availability of sustainably produced palm oil is unclear. A global certification system for sustainable palm oil has not emerged yet and thus finding a supplier that can respond the environmental demands of the developed countries may turn out to be very difficult. This possibility drives palm oil clearly to the direction of a strategic product. This unclear matter is solved in this study by taking two approaches to the purchasing of palm oil. Relying on long-term contracts is analysed in Chapter 4.3 and full vertical integration to oil palm cultivation is discussed in Chapter 4.4.

Soybean oil has not yet faced similar sustainability demands from end customers as palm oil. A reason to this might be that it is cultivated also in developed countries where mechanised farming has been carried out for years and forests cleared for plantations decades ago. However, there might be a change coming to this as South-America increases its role in soybean production. Partly due to this threat and partly due to the interest in the strategic aspects, full vertical integration is also analysed in the case of soybean oil. The main difference to the analysis of upstream integration to palm oil production is the number of steps taken towards the plantation. Soybean is an annual crop with a relatively low yield compared to oil palms. In addition, in developed

countries it is typically farmed in small units of land and thus the entrance of a large player in cultivation is anticipated to be blocked by governments to preserve traditional farming. This leads to the analysing of upstream integration to soybean crushing as one strategy.

The material for the analyses is mainly gathered by discussions with the management of Neste Oil's Biodiesel division and the members of the raw-material purchasing team. Additional details are provided from the author's own experience and discussions with industry specialists. Other sources of data have been pointed out in the text. This approach has been selected because of the low availability of strategic literature on the still young biofuel industry.

4.2 BUSINESS ENVIRONMENT SCENARIOS FOR 2010-2015

This chapter identifies major factors that should be taken into consideration when analysing different possibilities of upstream integration. The business environment that Neste Oil is facing evolves at a rapid pace and thus the number of possible future scenarios is high. To control the number of scenarios, this research uses three variables that are targeted to guide further qualitative analysis.

Each of the three sourcing strategies are analysed in all three scenarios. The applicability of the strategies to different scenarios is summarized in Chapter 4.6.

4.2.1 THE GLOBAL BALANCE OF VEGETABLE OIL SUPPLY AND DEMAND

European Union has three key drivers for biofuels (BIOFRAC, 2006). First, EU seeks to increase the demand for domestic agricultural products. In the recent past the agriculture business has been supported heavily with subsidies and incentives. Creating genuine demand for agricultural products would be in many ways a more economic and sustainable option than artificial demand created by subsidies. Second, EU seeks to decrease its dependence on imported mineral crude oil. This issue has been constantly raised to table as crises in the Middle East have escalated crude oil price during the last years. However, current crude oil price does not make production of most biofuels financially attractive without support from governmental mandates and subsidies. Third driver is the environmental aspect of biofuels which appears to attract the most active public discussion. Biofuels are produced from renewable resources that tie up carbon

dioxide from the atmosphere during the cultivation. Consequently, burning biofuels instead of fossil fuels creates a better balance between greenhouse gas (GHG) emissions and absorption.

The drivers for biofuels around the world are similar to the ones in EU. Yet, the main reason for supporting biofuels varies across the globe. Whereas developed countries are interested in reducing emissions, many developing areas see biofuels as a way to secure fuel availability and to reduce their dependence on fossil oil imports. When viewing the markets for biomass based diesel fuels, the differences in the mentioned fundamentals affect the end product demand. Biofuel consumption in developed countries is mostly based on governmental actions that aim to decrease GHG emissions whereas in developing countries the demand correlates more with mineral crude oil prices. When part of the global demand is tied into rather solid incentives and the other part is tied to the prices of other commodities, forecasting the future demand is fairly complicated. In addition to the varying raw-material demand for biomass based diesel fuels, it should be noted that the main demand driver for vegetable oils is still the constantly increasing use by food industry.

The uncertainty is elevated by the unpredictable nature of vegetable oil supply. In the case of seed oils, farmers have the option to choose periodically the plant that they produce. They make the decisions based on the price prospects of different plants and this may create substantial swings between the supplies of agricultural products. This phenomenon is currently visible in USA, where masses of farmers are changing to cultivate corn instead of soybean. This has resulted in an 11% drop in the cultivated area of soybean in USA (Bloomberg, 2007). The reason behind the change is the rising need for ethanol and the corn based sugar to produce it.

A situation where vegetable oil production would increase faster than consumption is possible, but very unlikely. This would require either the cultivated area to grow rapidly, significant breakthroughs in increasing yields, or large masses of farmers to start cultivating oil plants instead of other plants. As the growth on the demand side is vast, the option of supply growing faster than demand is left outside this research.

The first variable for further analysis is constructed to depict the above mentioned uncertainty in the global availability of vegetable oils:

I. The global balance of vegetable oil supply and demand:

A. The growth of vegetable oil demand outpaces the growth of supply

B. The balance of supply and demand remains at its current state

4.2.2 THE EXISTENCE OF PRICE PREMIUMS BETWEEN DIFFERENT VEGETABLE OILS

Vegetable oil prices are strongly correlated since many of the oils are substitutes to each other. An example of the correlation can be seen in Figure 4-2, which plots the prices of palm oil and soybean oil for a period of over two decades. The general price level of vegetable oils is a direct consequence of the supply and demand balance and the speculation about the balance in the future. As the balance is already taken into account in the first variable above, the focus in prices will remain in the premiums between different vegetable oils.

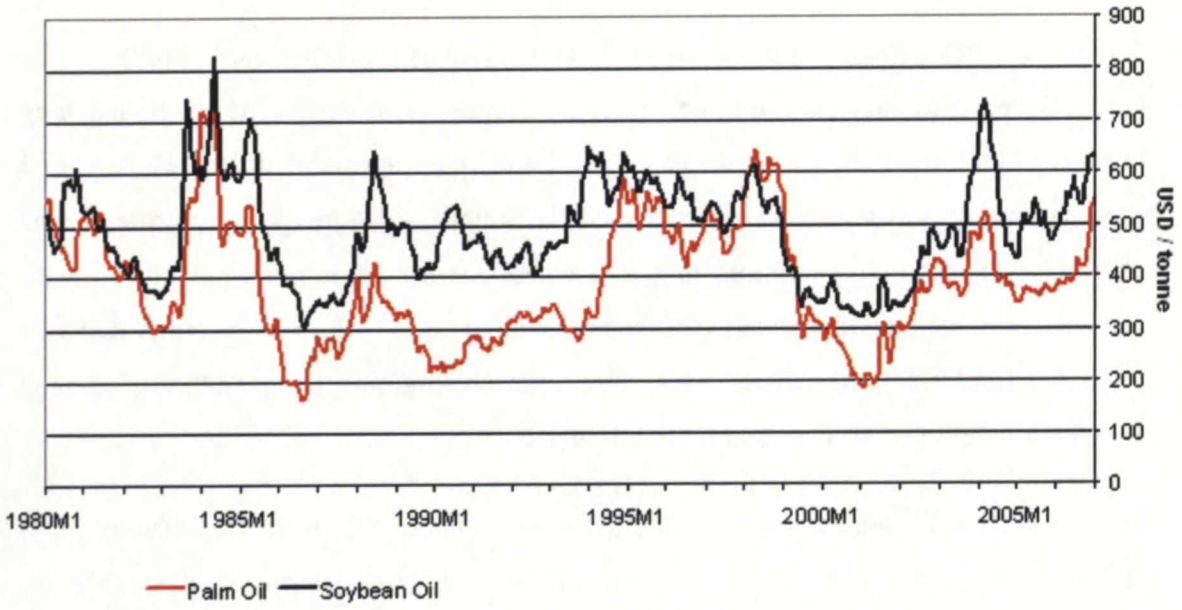

Figure 4-2 Prices of palm oil and soybean oil, 1980 - Jan. 2007 (IMF, 2007)

The decision to integrate upstream would tie Neste Oil into a closer relationship with a single vegetable oil. Therefore the price differences between different vegetable oils affect greatly Neste Oil's ability to gain financial benefit from the raw-material flexibility of NExBTL technology. Figure 4-3 shows the premiums of the top three most produced vegetable oils: palm oil, soybean oil and rapeseed oil. In the recent years

rapeseed oil has been the most expensive of the three followed by soybean oil. Palm oil has been constantly the least expensive. The premiums result partly from the different attributes of oils and their applicability to food production. Another strong contributor to the premiums is government policies controlling local supply and demand. The main cultivation areas of the oils tend to create incentives and regulations to support local production. For example, the use of pure soybean oil methyl ester, SME, in Europe is partly limited by one attribute in the European biodiesel specification. The specification does not take into consideration the fact that in some other attributes SME would be better than rapeseed oil based biodiesel, RME. This is one of the details that has made rapeseed oil the preferred feedstock for European biodiesel production and strengthened its price compared to other vegetable oils.

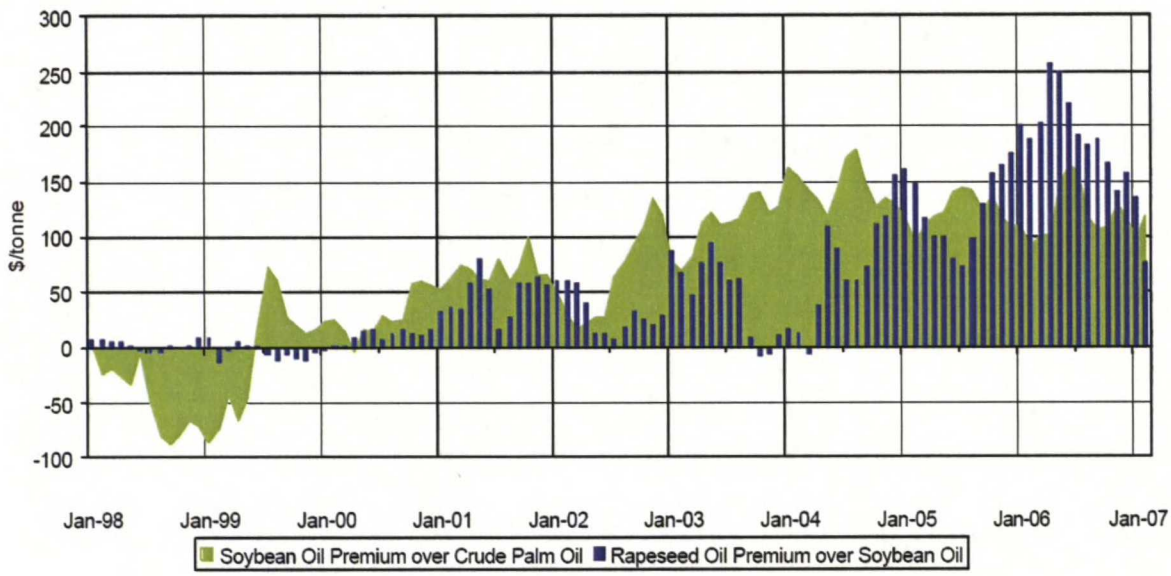

Figure 4-3 Key vegetable oil price differences at N.W. European Ports (LMC, 2007)

For the time span under consideration, it is hard to project how regional regulations affect the relationships of vegetable oil prices. Nevertheless, the effect of regulation and possible new applications that can accept only a single vegetable oil as feedstock may affect market mechanisms. The traditional correlations may weaken and lead to vegetable oils trading occasionally at very equal prices, but then at times with large differences in prices. Still, even without breaking the correlation relationships, the differences may happen to be very small due to market conditions. By looking at the chart on the previous page (Figure 4-2), it can be seen that palm oil and soybean oil have traded at considerably similar prices during 1997-1999.

These market mechanisms lead to the creation of the second scenario variable:

II. The existence of price premiums between different vegetable oils:

A. Different vegetable oils trade at substantial premiums compared to each other

B. The price gaps among vegetable oils become minimal

4.2.3 NESTE OIL'S RAW-MATERIAL DEMAND FOR NEXBTL PRODUCTION

The total feedstock demand for Neste Oil's NExBTL production will grow substantially in the future. Neste Oil has projected that the demand in 2012 is 2,5 million tonnes. Therefore this research views that the feedstock demand accumulates to 3 million tonnes near 2015. An alternative view could be that the demand in 2015 was significantly larger than 3 million tonnes. This could be the case if NExBTL production turned out to be highly profitable and enough resources existed to manage multiple plant projects simultaneously. Factors that could lead to faster development include a business environment where: end-product markets grow faster than expected, vegetable oils remain competitively priced compared to mineral crude oil, and global warming drives governments to establish higher targets for biofuel consumption. However, it could be argued that any additional projects would require the availability of non-food feedstocks such as Jatropha oil and algae oil. These renewable oils may become accessible in large quantities during 2010-2015, but the plant projects based on the availability of these raw-material resources would probably be completed after 2015.

Large scale demand for biofuels is created by two major factors. The first one is the governmental actions in developed countries where incentives and mandates are established to support biofuel consumption. The second factor is the global movement from fossil fuels to biofuels when the price of mineral crude oil reaches a level high enough compared to vegetable oils. Both of these factors may be disturbed and thus the attractiveness of NExBTL production may change. Neste Oil's current biofuel strategy follows the growth of EU's incentives to increase biofuel production. Scenarios where EU could reconsider its biofuel roadmap include: extraordinary demand for vegetable oils as food (e.g. global crisis such as war or acts of nature that harm vegetable oil production in large scale), scarcity of arable land (e.g. biofuels start to be the main driver of rainforest depletion) and unexpected problems in using biofuels with current engine technology. The aspect of mineral oil prices is very hard to predict as the

markets are highly speculative and prices volatile. An era of low crude oil prices could in worst case limit the growth of biofuel industry to the demand level created by governmental incentives.

Financial, raw-material and personnel resources may each become the bottleneck for new NExBTL projects and thus limit the increases in production capacity. Financial resources may be affected, for instance, by a recession that causes the general propensity to invest decline. The first variable introduced in this chapter concerned the balance of supply and demand of raw-materials. In case the increase in supply fails to follow the rising demand, also the raw-material availability may start to affect also Neste Oil's investment decisions.

The above can be concluded into the third variable used in this research:

III. Neste Oil's raw-material demand for NExBTL production:

- **A.** Neste Oil requires annually 1,5 million tonnes of feedstock
- **B.** The demand for feedstock is 3,0 million tonnes annually

4.3 STRATEGY 1: SOURCING PALM OIL WITH CONTRACTUAL RELATIONSHIPS

Palm oil and its fractions have been among the least expensive vegetable oils for the recent years. Consequently, palm oil is an attractive feedstock option in terms of direct raw-material costs. However, palm oil meets resistance from the end product markets, not least because it does not comply very well with biofuel drivers of many developed countries (see Chapter 4.2.1). Oil palms do not grow in EU or USA and thus using palm oil would not support domestic agriculture. Secondly, using palm oil would not free producers of fuels from the reliance on imported supply from a handful of countries. Comparing palm oil with mineral crude oil, the production is even more geographically concentrated. Palm oil is produced in large quantities only in Malaysia and Indonesia, whereas crude oil can be, after all, found in several parts of the world. Finally, palm oil based biofuels' contribution to environmental matters is constantly questioned. When cultivated on wastelands, palm oil is a sustainable feedstock for biofuels (WWF, 2007). In contrary, if the cultivation requires cutting down forests or even worse, clearing them by burning, palm oil's contribution to greenhouse gas emissions is daunting.

The following subchapters present long-term contracts in general (Chapter 4.3.1) and examine how contract relationships can be created (Chapter 4.3.2). Chapter 4.3.3 analyses palm oil contracts by specifying financial factors. The last subchapter (4.3.4) discusses the effects of different future scenarios on financial, feedstock security and sustainability issues.

4.3.1 CONTRACT CHARACTERISTICS

Sourcing palm oil with long-term contracts could be a possible strategy for NExBTL plants located in any continent. Current shipping networks allow the transportation of palm oil to even the most remote locations. As Table 4-2 shows, the roles of Malaysia and Indonesia are dominating in palm oil production. Consequently, sourcing large quantities of palm oil through long-term contracts means purchasing palm oil directly from Southeast Asian producers or from middlemen that deliver palm oil from logistics hubs.

Table 4-2 Palm oil top-5 producers in 2005 (FAOSTAT, 2007)

Palm oil	*tonnes / a*
World total	34 364 000
1. Malaysia	14 962 000
2. Indonesia	14 070 000
3. Nigeria	1 170 000
4. Thailand	685 000
5. Colombia	673 000

In this chapter long-term contracts are viewed to last for a time period of 2-3 years. Shorter contracts would hold back building cooperation between Neste Oil and the supplier. The contracts are considered to be binding at least on the minimum quantity to be delivered. Usually the contracts include a range of quantity from where the buyer, or in some cases seller, is allowed to determine the final quantity delivered. Pricing may be either tied to market quotations or agreed to be partly or fully fixed beforehand.

4.3.2 BUILDING LONG-TERM RELATIONSHIPS

One particular question in building contract relationships with palm oil suppliers is how to persuade them to long-term delivery contracts. Several palm oil suppliers plan only months ahead in making sales contracts. From the palm oil supplier's point of view, the product market is volatile and bullish price environment discourages making deals on

fixed prices. Neste Oil has to find ways to offer some special value to suppliers to be able to secure quantities for long periods through contracts. Easiest, but at the same time possibly the most expensive way would be to offer higher premium to a market price than the suppliers receive from their short-term clients. Market prices are, in addition, a difficult means of purchasing raw-materials for a producer of vegetable oil based diesel. The value of NExBTL is determined mainly by the price of mineral oil products and the balance of supply and demand of biofuels. Only if mineral crude oil price strengthens significantly compared to vegetable oils, the prices of vegetable oils start to affect demand and pricing of the end product. In other words, currently the prices of raw-materials and end products live a separate life which means fluctuating refining margins.

There are several benefits that can be used to convince suppliers to agree on long-term contracts on fully or partly fixed prices. (1) In long-term contracts suppliers have lower transaction costs than in short term contracts. Savings come from committing less effort on sales negotiations, lower quantity of risk analyses and less need to project short-term market reactions. (2) Long-term contracts can be used to secure part of the sales quantity. This will provide a solid income basis for the supplier to live through the occasional difficult times. Furthermore, long-term contracts can be used as tools to convince investors and in some cases as guarantees when obtaining financing. (3) Fixed price contracts reduce income volatility of an oil supplier. Decreased volatility helps to make long-term financial calculations and to reduce the need for short term financing to balance cash flow. Reduced need for short term financing is typically reflected in lower financing costs.

In addition to communicating the benefits above, the suppliers may be persuaded by other means as well. Since one of the suppliers' reasons against fixed pricing is the belief in rising prices, non-bullish projections could be used to depict alternative future environments. These projections are occasionally available by third party analysts. In addition, the fact that vegetable oil prices have had significant drops in the past years could be brought into conversation. As Figure 4-2 earlier in this research showed us, palm oil prices dropped over 50 % during 1998-1999.

4.3.3 FINANCIAL FACTORS

Financial factors will be analysed by costs of contracting, required investments, raw-material and logistics costs, and risk management practices.

Costs of contracting

Costs of contracting occur when the supply contract is prepared, operated and managed. Preparing includes expenses from screening possible suppliers, engaging in negotiations and finalizing a contract. Operative costs cover the costs of implementing the contract. In long-term contracts, this requires effort from production planners and coordinators to manage deliveries and to settle transactions. The third aspect in expenses of contracting is the costs of managing supplier relationships. Supplier management is an area where long-term contracts can especially have a lead over short term contracts. A good relationship with suppliers can facilitate advanced supply chain management practices targeted to reduce delivery and inventory costs. In addition to smoother flow of information and products, a well managed contract builds trust among the participants which may lower the costs of future contract negotiations.

Required investments

Long-term contracts with palm oil suppliers do not necessitate large investments. Needs may arise in the area of logistics facilities that include warehousing space at NExBTL processing units. Since the supplier performance is not secured and transparent to buyer, there is a need to keep a buffer stock to balance for possible problems in deliveries. Whereas investments are not necessary, they may offer new ways to benefit from contracts that are stable for long periods.

As noted above, good relationships with suppliers may offer ways to enhance information transparency to the benefit of both the seller and the buyer. In this area investments may be targeted to build information networks and automated processes. One example could be that the supplier would be able to access buyer's production plans and stock levels. This would help the supplier to plan their own production as they would have access to the best forecast of how much raw-material is going to be demanded. The system could provide benefits to the buyer as well. If the buyer were able to follow the production of the supplier, it could react faster to problems in supply and possibly reduce the level of safety buffers in stock levels.

One possible area of investment in long-term contracts is financing the supplier to guide its operations to cater the needs of end customers better. In the case of palm oil cultivation this could mean providing support to start new plantations on already logged areas instead of untouched forests, increasing worker safety and well being by investing in safety equipment, housing, schools etc., and supporting activities to save endangered species. This type of environmental support could be provided, for example, by financing national parks indirectly through the palm oil supplier. In the processing of oil palm fruits the investments could be directed to support waste treatment and to reduce emissions. One example could be investing in palm oil mill effluent (POME) treatment techniques that target to use the effluents as fertilizers and sources of energy instead of releasing the waste to local waterways.

The investments and cooperative projects presented above could be used as "financial hostages" to bind suppliers to long-term contracts since terminating the contract would mean reducing the value of joint investments (Dyer, 1997: 537).

Raw-material and logistics costs

Raw-material and logistics costs are the largest expense in sourcing with long-term contracts. The determinant factors in this area are the specific raw-material grade, price and quantity as well as timing, terms and methods of delivery.

In the case of palm oil, specifying the oil grade presents a dilemma in long-term contracts. The premiums between different palm oils are discussed in Appendix A and it is concluded that, for example, stearin can trade at times at a premium compared to crude palm oil (CPO), but usually remains less expensive than CPO. If the contract is tied into a specific grade, it may occur that Neste Oil ends up paying premium in a case where it does not have any incentive to use the more expensive grade. This is a detail that could be managed to an extent as the following example shows. If Neste Oil purchases palm oil from a conglomerate that produces both CPO and refined grades, the contract could be tailored to work so that the delivered grade is always the least expensive. The producer would have the possibility to deliver the grade that has least demand at that moment and the buyer would always receive the least expensive grade of palm oil. In practice this is nearly impossible in the current market environment since CPO is the only grade quoted in exchanges. One way to cash on the raw-material flexibility in the contractual level could be selling a grade flexibility option to the

supplier. If the supplier agrees on a larger discount, it could be offered the option to deliver any product from an array of predefined products. This could include items such as CPO, RBD Palm oil, RBD Olein, RBD Stearin and their blends with palm fatty acid distillate (PFAD) to a certain degree.

To tackle the uncertainties related to launching new refineries, Neste Oil could use RBD Olein as the first feedstock of new plants. In case the launch is postponed, RBD Olein could possibly be traded back to the markets more easily than crude palm oil or side products of refining such as PFAD or RBD Stearin. RBD Olein can be used by food industry and FAME-producers whereas other palm oil grades have more limited customer base. In addition, RBD Olein can be used without pre-treatment and thus possible problems at pre-treatment facility would not hinder the launch of NExBTL production. The cons include increased raw-material costs and the need to keep the oil separated from other raw-materials to be able to achieve the benefits.

Moving to other cost factors, quantity determines the leverage in making the supply contract. It is hard to determine how much Neste Oil should source from a single supplier to have increased power in price negotiations. In a general level, quantity discounts are possible to attain if the demand of a single client is large enough to reduce supplier's transaction costs compared to a situation where it sells to several clients. Since the customer bases of suppliers vary, this is a factor that could be included in supplier analysis prior to negotiations.

Timing, terms and methods of delivery form the basis of logistics costs. The lot sizes, frequencies and carrier decisions can be fairly easily optimized for single units, but these all have a deep effect on company wide stock levels. Taking a strategic view covering the whole supply network that includes all NExBTL plants and all suppliers, several different possibilities in arranging the sourcing chain can be identified. Three of these possibilities are illustrated in Figure 4-4 by using a scenario where Neste Oil has three different palm oil suppliers and five plants of varying size.

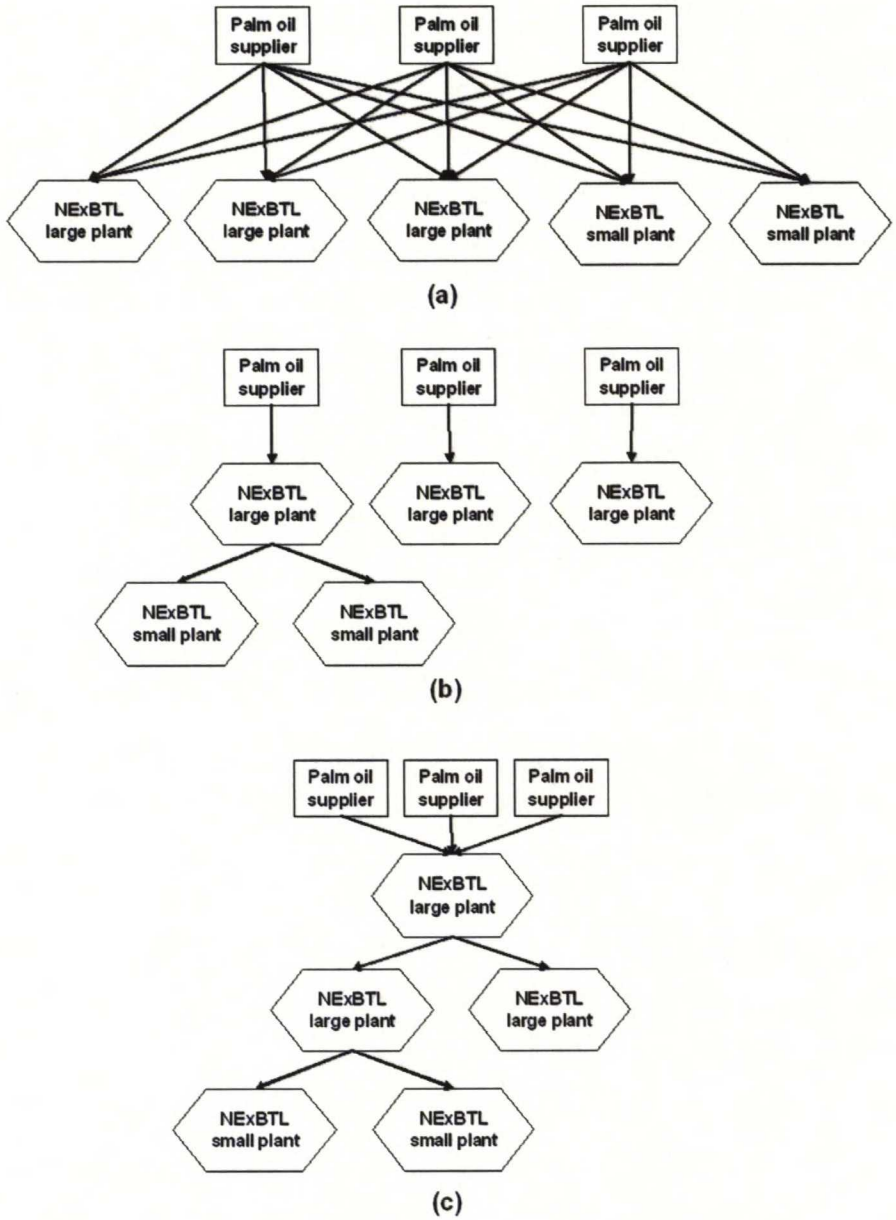

Figure 4-4 Sourcing chain possibilities for palm oil

Chain (a) pictures a situation where any single shipment can be directed to any NExBTL plant regardless of the supplier. This setting has its strengths in securing supply since problems at one supplier or production unit do not affect the raw-material availability at other NExBTL plants. The downside is separate safety stocks at each production unit, small lot sizes in transportation and demanding coordination of shipping. Chain (b) is developed from (a) by selecting primary suppliers for each large production unit and using large plants as cross-docking terminals for smaller plants of the area. This setting is considerably easier to coordinate than situation (a) and transfers pressures to keep stocks at small plants to consolidated stocks at large plants. This setting is, however, very vulnerable to problems at a single supplier. Chain (c) uses one

plant to consolidate all streams from palm oil suppliers. Compared to (b), this divides the risk of supplier problems to multiple plants instead of a single one. If the consolidating plant is located near to the suppliers, the setting enables the use of a higher number of suppliers with considerably less coordination troubles than in chains (a) and (b). The risks in (c) are obvious. If the consolidating plants have problems in deliveries, for example due to political climate or because of operational problems such as congestion at harbours, the whole chain suffers. In a stable situation this setting may provide savings in shipments and warehousing, but the performance is finally subject to projections created by modelling the chain. This is an important area of further research prior to the launch of new NExBTL plants.

Risk management practices

In sourcing the tasks of risk management include protecting the company from price risks and logistics risks. Price risks arise from fluctuations in global prices and exchange rates. Logistics risks are present in shipping and warehousing.

In long-term contracts of palm oil, the buyer may want to refrain from speculating with prices and thus encourage minimizing the fluctuations in price. This can be achieved by creating contracts on partly or fully fixed price levels. Another way to manage the price risk is to use futures or options contracts to create a position to balance changes in price quotations. Palm oil futures are traded currently at Bursa Malaysia Derivatives (BMD) market with contracts available up to 24 months forward. However, liquidity exists only for futures that are settled in less than 4 months. In addition, BMD quotes futures only in Malaysian currency, ringgit. To attract international traders, BMD has announced that it is planning to launch US dollar based instruments as well. In June 2007, the Singapore-based Joint Asian Derivatives Exchange (JADE) launched its competitor to BMD's crude palm oil futures with quotations based on US dollar. JADE is an electronic derivatives market created in a joint venture by Chicago Board of Trade and Singapore Exchange. In conclusion, the price risk of long-term palm oil contracts can be directly balanced only by over-the-counter forward contracts offered by financial institutions. Since palm oil price correlates strongly with other vegetable oil prices, the possibility to hedge sourcing contracts through other commodities should be investigated.

Logistics risks vary with the selected terms of delivery. In general, the risks in freight prices can be moved to supplier by using delivery terms that include shipment. However, the most common delivery term of this kind, CIF, passes the risk of the title to the buyer already when the shipment is loaded. The use of Group D of Incoterms 2000 (DAF, DES, DEQ, DDU and DDP) could provide help in managing shipping risks, but these terms are not very common in shipping by waterways. Thereby protection from physical risks in delivery and warehousing can be assessed mainly by insurances. One way to address this situation is to invite the supplier to keep raw-material stocks at NExBTL plants and thus the transactions could be done as in-tank transfers. This could add value to Neste Oil in the form of lowered warehousing costs, but could expose the company to a new set of risks, e.g. in securing product availability.

4.3.4 SCENARIO ANALYSIS

This subchapter uses the scenarios presented in Chapter 4.2 to discuss the effects of different future outcomes.

I. The global balance of vegetable oil supply and demand.

A. The growth of vegetable oil demand outpaces the growth of supply

B. The balance of supply and demand remains at its current state

Financial perspective

In both scenarios, A and B, it is assumed that the global demand of vegetable oils grows from the current level. The difference between the two scenarios is mainly on the supply side, i.e. how the production is able to respond to rising demand. In parts of this analysis vegetable oils are viewed as a single entity since in many applications the oils are substitutes to each other.

In scenario A, the lack of supply would mean that either some of the new or traditional applications have to withdraw from using vegetable oils. The prices would climb to record highs and force the industry to reshape itself dropping out the processors that are not able to transfer the rising raw-material costs to end product prices. The question of how the effects would realize is hard to predict. Food processors are the main users of vegetable oils and consequently the global focus would be primarily on the food availability. In developed countries the reaction could be rising food prices, but in undeveloped countries the effects could be far different. Despite the health concerns,

food processors in undeveloped countries could move to use the less healthy animal fats instead of vegetable oils and ultimately limit product availability causing starvation. Since this kind of development is hardly acceptable by global standards, the pressure would be directed to technical uses of vegetable oils. This could happen in the form of decreasing biofuel incentives and encouraging other technical processors to consider mineral oils as an option. In the special case of palm oil, the local nature of production has to be considered. If Malaysian and Indonesian food processors start to be short of palm oil, the governments can be pushed to increase export barriers to ensure food availability. From a financial aspect this could mean very high raw-material prices.

The financial effects of scenario B are not as clear as in the case of scenario A. One view could be that to keep up with the demand, vegetable oil plantations have to expand to areas that are not as suitable for cultivation as the current areas. In practice this could mean lower yields, higher cultivation costs, expenses of clearing new plantations and vast sustainability issues. Increasing vegetable oil supply could, by this logic, increase vegetable oil cultivation costs and consequently product prices. However, part of the increase will result from developing cultivation practices and the actual plants to increase yields. Increasing vegetable oil supply this way could have a more neutral effect on prices. The development in cultivation has often its downsides from the environmental perspective since the increased use of machinery, fertilizers, herbicides, pesticides and genetically modified crops affect the nature in many ways.

Feedstock security

In Scenario A securing raw-material availability is a problematic issue. The question can be approached from the food industry's point of view. The actions available for food producers to secure their vegetable oil supplies are paying higher prices, gathering forces to lobby against alternative uses of vegetable oils and finally integrating into production to be able to control the supplies. Biodiesel producers could in some cases be able to live with increasing feedstock costs, but the effect of the latter two actions would cause serious problems. Governments may be more likely to defend food processors than biofuel producers if the competition creates serious problems in food availability. The third option including upstream integration would mean that suppliers in Neste Oil's long-term contracts would be in increasing amounts multinational food producers such as Unilever. Another entity that might be interested in similar upstream integration is large FAME producers. Currently there are no large biodiesel

conglomerates, but the situation may change in the upcoming years. The industry might consolidate into few major companies that come from the agriculture business or mineral oil business. The candidates include companies such as ADM, Bunge, Cargill, Shell, BP, ExxonMobil and ConocoPhillips. All these companies have a history of sourcing their raw-materials by integrated supply-chains and thus it would not be a surprise if they sought to control biodiesel feedstock resources as well. A situation where Neste Oil has to rely heavily on supply contracts with its competitors on the end product markets or an industry that is lobbying against biofuels could prove to be unbearable. In such an environment long-term contracts are hardly an option to secure long-term supplies. Another aspect in case of palm oil is the stability of Malaysian and Indonesian politics. As opposed to more developed countries, these two could establish sudden barriers for palm oil exports if the local well-being so demands. In long-term contracts this could be handled in two ways. First, contracts should be written in such a way that when export problems arise, leaving Neste Oil without supplies would cause the supplier to suffer greatly instead of being able to lean on force majeure. This would help Neste Oil to receive prioritized streams of palm oil. Second, the suppliers should be selected partly based on their ability to influence local decision making and gaining special licences for exports. In practice this means contracting with the largest suppliers and state controlled players.

In Scenario B long-term contracts to source palm oil would be an applicable way to secure raw-material availability. However, as the sourced quantities rise, the purchasing may start to be affected by country level interests. Even though the balance of palm oil supply and demand would remain at its current state, the producer countries face the question of how to allocate their export streams. This question would be even more important in scenario A, but arises already in scenario B. For instance, India's and China's economic importance in Asia may cause Southeast Asian countries to prioritize these countries in their export decisions to enhance bilateral relationships. If Neste Oil decides to use large quantities of palm oil, it could be possible to encourage Finnish government to strengthen cooperation with Southeast Asian countries to keep Neste Oil's supplies secured also during the downs of palm oil production.

Sustainability issues

Sustainability issues related to producing palm oil are present in both scenarios. In Scenario A the problem is the lack of incentives to invest in better cultivation practices and in Scenario B the expansion of plantations to new areas.

In Scenario A palm oil demand exceeds the supply by large numbers. As a result, palm oil producers have freedom in choosing their customers and thus it would be difficult for a single customer group to demand sustainable cultivation practices. The improvements in sustainability issues would require the buyers to pay a significant premium to be able to encourage producers to invest in changing their practices. Currently sustainability issues are driven by developed countries, while large developing importers of palm oil, for example China and India, are less interested in the oil's origin. Consequently, it is to be seen how much developed countries would have to pay premium over the normal price for sustainability certified palm oil. Some indication can be sought by looking at the certification practices in the coffee market. Starbucks (2007) informs that 53 % of its coffee purchases in 2006 were sourced from suppliers meeting C.A.F.E. Practices -criteria which targets to improve the social and environmental effects of coffee cultivation. The price paid for the sustainably produced coffee is around 70 % above the average market price. If the palm oil price premiums rise to similar percentages in Scenario A, the price advantage compared to other vegetable oils is most probably lost. Thus it may be possible that in Scenario A sourcing sustainable palm oil with long-term contracts is not a financially viable option.

In Scenario B the position of developed countries is stronger than in Scenario A as the supplies are not as scarce. However, the expansion of plantations presents new problems as there is limited arable land area available for oil palms. WWF (2007) claims that there is plenty of fallow land in Southeast Asia that could be used for cultivation, but it would be unrealistic to project that the whole expansion would realize without harming tropical forests. In other words, part of the new oil palm plantations are probably going to be cleared without respecting sustainability criteria. In this scenario sourcing sustainable palm oil would mean buying oil sourced from already established plantations. This creates an environmental dilemma. If developed countries buy the sustainably cultivated palm oil, it forces the developing countries to purchase oil that is not produced in an environmentally sound manner. Thereby buying sustainable palm oil may indirectly cause further depletion of rainforests. These indirect sustainability

problems are difficult to solve by long-term contracts. Neste Oil can affect the issue on the corporate level by sourcing only from suppliers that do not expand their plantations to rainforests and encouraging other companies to follow the same practice through cooperation in organizations such as Roundtable on Sustainable Palm oil. The effects should start to realize when the cooperation covers also undeveloped countries that currently have little incentive to respect environmental concerns regarding palm oil.

II. The existence of price premiums between different vegetable oils.

A. Different vegetable oils trade at substantial premiums compared to each other

B. The price gaps among vegetable oils become minimal

Financial perspective

Under the second variable, scenario A pictures the present market environment fairly well. The selection of raw-material is a critical question in terms of raw-material costs. In this type of environment it is moderately easy to obtain competitive edge in biodiesel markets by being able to use several different vegetable oils. Scenario A does not, however, bypass the situation where the order of different vegetable oils on the pricelist changes. In case Neste Oil has tied long-term contracts with palm oil suppliers, it requires special actions to change raw-material to a less expensive one. One way to do this could be by building exit possibilities, such as buy-back arrangements, into contracts. In case the supplier is willing to provide such possibility, the cost would probably be high since the value of the contract to the supplier decreased considerably. On the other hand, scrapping the contract is not the only possible action. The more economic way to get rid of palm oil volumes could be trading it to third parties at market prices. Trading suddenly large spot quantities has its difficulties since the quantities moving on spot markets are much smaller than NExBTL feedstock shipments. Small lots pose high transaction costs and may in practice prove to be impossible to sell off. The problem is immense in crude palm oil markets where buyers and suppliers are generally the same small group of conglomerates. Using refined palm oils, it could be easier to reach more customers in case the feedstock has to be traded out.

Scenario B is an interesting possibility. The value of raw-material flexibility would be very different than today. Feedstock selections would be based more heavily on supply security and sustainability issues. The role of other costs would rise in the financial

evaluation of raw-materials and, for example, the shipping costs could be the final determinant in deciding raw-materials. In practice the most economic option could be using local feedstock to a maximal extent and thus avoiding shipping costs. This kind of sourcing would, in contrast, decrease the economies of scale in global purchasing and be difficult to coordinate centrally.

Feedstock security

Price differences between different vegetable oils may not have a direct effect on availability. However, different basic assumptions in pricing could change the behaviour of palm oil buyers and thus affect the market environment. Scenario A and the case that palm oil is cheaper than other vegetable oils presents the current position. Countries that do not produce palm oil use it in applications where its characteristics are not optimal, but the low price is able to justify the usage. This could change if palm oil's price moved to trade at a higher level compared to other major vegetable oils due to production problems or other issues. One special case that could turn out to be problematic in this case is using the side streams of palm oil refining. For example, some of the refining capacity is located in Europe and if the demand for the main fraction, RBD Olein, declined it could cause a decrease in the availability of other products such as PFAD and RBD Stearin. In other words, if RBD Stearin were still an attractively priced option as NExBTL feedstock, its availability could suffer from a decline in RBD Olein's use.

Scenario B would have similar effects as the scenario where palm oil would become more expensive than other vegetable oils. One special case to note is the biodiesel industry's incentives to use different vegetable oils. In the traditional FAME biodiesel production palm oil is not as good a raw-material as soybean oil or rapeseed oil. If the price premiums were nonexistent, the usage of palm oil in biodiesel production could decline to a very low level. This would create a market where Neste Oil is among the few biofuel producers sourcing palm oil. It is hard to conclude whether this is a positive or a negative change from the availability perspective. On the positive side would be the overall declined demand, but on the other hand, the world wide availability could worsen if the demand concentrated to Asia.

III. Neste Oil's raw-material demand for NExBTL production.

A. Neste Oil requires annually 1,5 million tonnes of feedstock

B. The demand for feedstock is 3,0 million tonnes annually

Financial perspective

A major question before approaching these scenarios is how big share of the total raw-material demand should be covered with one major feedstock source. Discussions inside Neste Oil Biodiesel organization provided many different views to this matter. However, many agreed that the amount should be substantial, meaning anything from 30 % upwards. The upper limit varied a great deal, that is from 50 % to 80 %. The lower limit is determined by how big share of the feedstock supply should be secured in terms of price and availability. In the case of palm oil, the goals are especially in improving financial efficiency by using the least expensive raw-material to a large extent. Another aspect in determining the lower limit is having economies of scale in purchasing. While by direct raw-material costs it could sound attractive to use amounts such as 90 % of palm oil, high shares of single feedstock may cause problems. In the case of palm oil, the sustainability problems discourage using high amounts of the single feedstock since there is the risk of consumers labelling the end product as pure palm oil biofuel. In addition, there might be incentives that encourage using local raw-materials as a part of the supply to gain market area approval.

Based on the above, this paper uses 50 % as an assumed share of the single major feedstock. As a consequence, scenario A means a demand of 750 000 tonnes of palm oil annually. To put the amount into perspective, it can be compared to the exported palm oil quantities of Malaysia and Indonesia. According to USDA (2007) Malaysia exported 13,1 million tonnes in 2006 whereas Indonesia exported 11,6 million tonnes. Neste Oil's 0,75 million tonnes is 3 % of the combined exports of these two countries. It is notable that the figures consist mainly of refined palm oil grades and the percentage would be significantly higher if only crude palm oil were considered. Malaysia has a quota for duty-free CPO exports that is 10 % of the projected production and is divided between the largest producers. Consequently, MPOB (2007) statistics show that only 2,3 million tonnes of Malaysia's exports in 2006 were crude palm oil. Crude palm oil production of the five largest Malaysian based companies range from approximately 600 000 tonnes/year to around 3 000 000 tonnes/year. The two companies achieving production

of over 1 000 000 tonnes/year are state owned FELDA and the newly merged palm oil giant, Synergy Drive. Sourcing 750 000 tonnes of palm oil per year is in this context a challenging task if the objective is to keep the number of suppliers small. Limiting the number of suppliers would be advisable to be able to benefit from centralised procurement and low transaction costs. It would also help to control that the oil comes from sustainable origins.

Scenario B would mean sourcing 1,5 million tonnes of palm oil annually. If Neste Oil were a country, 1,5 million tonnes would have put it between Pakistan and Netherlands as the fourth largest palm oil importer in 2005 (Oil World, 2006). Thus it can be concluded that in this scenario Neste Oil's position in the world markets of palm oil would be substantial. From the viewpoint of logistics coordination 1,5 million tonnes is not an immensely large quantity if compared to, for example, Neste Oil Porvoo mineral oil refinery's annual capacity of 11 million tonnes. However, the introduction of large feedstock demand should be carefully planned and the quantities increased by steps to avoid creating adverse market reactions. These reactions could include governmental interventions to secure local palm oil availability and soaring prices. However, one of the largest problems is the current unavailability of liquid risk management derivatives. In case the future trade of palm oil does not activate for longer terms than four months ahead, the contracts may have to be concluded at relatively high fixed prices to control the feedstock price.

Feedstock security

Sourcing large amounts of palm oil highlights the country risks of Malaysia and Indonesia. In both scenarios, A and B, the same risks apply. As the reports below show, long-term contracts are applicable ways to secure raw-material availability with Malaysian companies. On the contrary, trading with Indonesian counterparts includes many country related risks that may affect the contract performance.

Finpro (2007) country analysis shows that Malaysia's strengths are in well developed infrastructure and relatively low level of bureaucracy. Negative aspects include weaknesses in financing and banking sectors. ONDD (2007) rates Malaysia's political risk to second lowest level (2/7) in transactions with a credit period of over 2 years. Commercial risk is considered to be on the normal level (B of A/B/C), which means that the country is healthy in means of general economic terms.

Finpro (2007) views Indonesia as a more turbulent environment for business than Malaysia. Strengths include the current stable position of the government, rapid economic development and single victories in the campaigns against corruption. However, Indonesia is still one of the most corrupted countries in the world. Other problems include unreliable judiciary, laws that are open to interpretations, stiff bureaucracy and political instability. ONDD (2007) rates Indonesia's political risk in medium/long-term contracts to be high (5/7). Commercial risk is high (C of A/B/C) due to aforementioned corruption problems and other difficulties in economic transactions.

The above mentioned reports do not assess the risks of natural hazards in Southeast Asia that may affect oil palm plantations, processing steps or general business environment. UNEP (1997) points out that Indonesia and Malaysia may be affected by multiple hazards such as earthquakes, tsunamis, floods and droughts. Almost the entire Indonesia stands on a seismic zone which results in constant earthquakes and over hundred active volcanoes. Malaysia is located north from the earthquake zone, but still stands the risks of experiencing the side effects of larger earthquakes, for example tsunamis. Drought and floods are in many cases connected to El Niño phenomenon that affects the whole Southern Pacific. These kinds of acts of God fall into the category of force majeure in contracts and are thus hard to manage by other means than geographical dispersion of raw-material suppliers.

Sustainability issues

As noted above, purchasing large quantities of palm oil would require using several suppliers as only few companies can supply quantities around million tonnes. Conducting sustainability audits to a large number of suppliers requires extensive resources and may make it difficult to trace the origin of single oil cargoes. To eliminate the need to be able to trace the cargoes to plantation level, Neste Oil should support the building of widely accepted certification systems that target to certify cultivation practices of entire companies. The target should be that determining the originating company and area should be enough to convince end users that Neste Oil only uses suppliers that fill its sustainability criteria.

Both of the two scenarios meet the same problems of controlling the sustainability of several suppliers. However, if Neste Oil sources 1,5 million tonnes of palm oil annually as in Scenario B, it draws an increased amount of attention from environmentalists,

media, competitors and end users. This can affect the applicability of using long-term contracts to source palm oil as the major feedstock through the company image. If media links Neste Oil constantly to all news related to palm oil and its sustainability problems, the image will be hurt even though all the sourced feedstock had been produced sustainably. The situation could be compared to fast food industry. If new studies show that fast foods cause a specific disease, the media will probably mention McDonalds even though if the company were not related to the particular case. Becoming the forefront of palm oil's problems can be avoided only by staying under the radar by avoiding using palm oil in large quantities. To manage the problem, Neste Oil should keep its name clean from any negative publicity already before it becomes a major player in palm oil markets. In addition, Neste Oil can work on behalf of palm oil in presenting its positive sides and directing stakeholder focus to other raw-materials in use. In conclusion, the image that Neste Oil creates in the public is as important as the way Neste Oil manages the actual sustainability issues.

4.4 STRATEGY 2: UPSTREAM INTEGRATION TO OIL PALM CULTIVATION

Investing in oil palm plantations and palm fruit processing would be a major step for Neste Oil. The current core competencies lie in the areas of refining and marketing clean traffic fuels. However, Neste Oil has been involved in the production of mineral crude oil throughout the years and has only in 2005 divested its last holdings in the area of oil production. In this context, upstream integration would not be a new sourcing strategy for the company.

The emerging industry of biodiesel provides several reasons that support the strategy of investing in raw-material production. First concern of the companies sourcing vegetable oils is securing feedstock deliveries. The sudden growth of biodiesel industry has put a strain on vegetable oil availability as the production has not increased at the same pace as demand. Second concern is the volatility of vegetable oil prices and their effect on refining margins. As noted in Appendix A, refining vegetable oils and producing biodiesel are often low margin business. Consequently, the continuity of operations may be threatened by sudden ups in raw-material prices. Third reason, concerning especially palm oil, is the pressure to control the sustainability of the raw-material source. Holding assets in oil production would enhance the ability to control the practices used to produce the raw-materials.

The following subchapter (4.4.1) introduces the frames of upstream integration through ownership in the palm oil supply chain. Next, Chapter 4.4.2 analyses the expenses related to acquiring and running a palm oil division. The applicability of the strategy in different future environments is discussed in the following subchapter (4.4.3).

4.4.1 INTEGRATION BY OWNERSHIP

Feedstock security and lower price volatility could be attained to a degree by investing in processing steps after the plantations, but controlling the sustainability issues demands strong involvement in the actual cultivation step. In conclusion, an effective investment should cover the steps from cultivation and oil extraction to oil refining / pre-treatment.

Investing in palm oil production can be done at differing stakes. The possibilities range from minority ownership to full ownership. This analysis will be based on a case where Neste Oil would have a majority ownership of an integrated palm oil company that cultivates oil palms, runs fruits through the mills and has facilities such as terminals and warehouses to facilitate deliveries to NExBTL plants. The reason to a majority ownership is the need to be able to control the decision making of the company. Neste Oil would benefit from being able to source palm oil with fixed prices and in self-determined quantities. In addition, Neste Oil could have a strong control over the cultivation practices. A minority partner in a joint venture could bring value to the company by providing experience and connections in palm oil industry, but also by providing local commitment to the project to please domestic stakeholders such as authorities.

As the time span under consideration in this research is short, from 2010 to 2015, it is important to consider how Neste Oil could enter the integrated position rapidly as well as exit from the position. Investing in oil palm plantations could be done by purchasing established entities or by starting new greenfield projects. Established large scale palm oil cultivators can be found in Malaysia and Indonesia whereas greenfield projects could be initiated also in West Africa, Middle America and South America. Suitable tropical areas for oil palm cultivation can be found 20 degrees of the equator as pictured in Figure 4-5, which also plots the five largest palm oil producer countries.

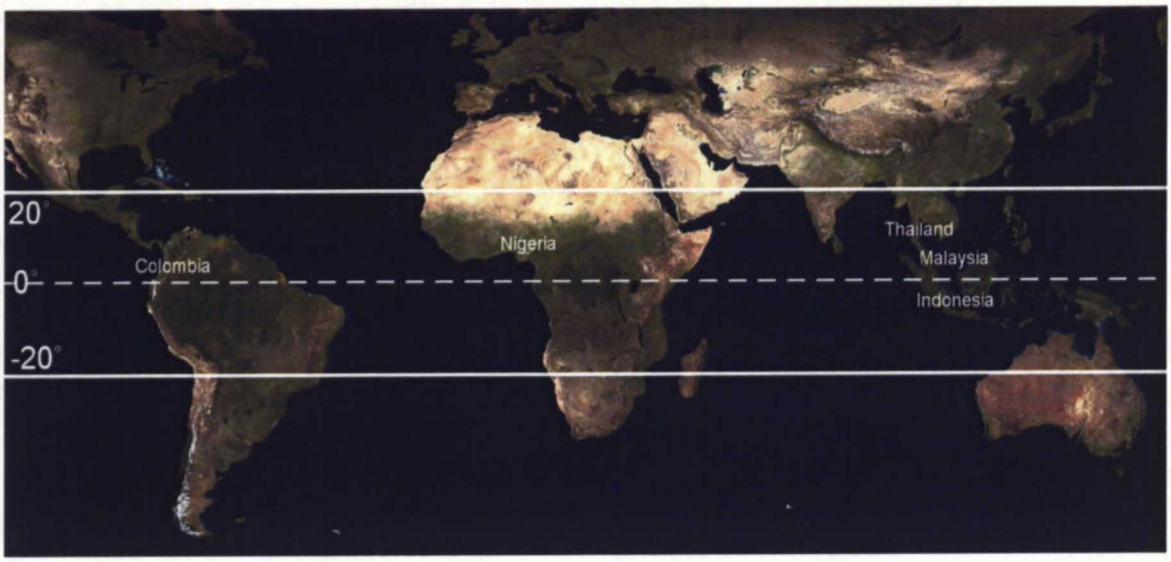

Figure 4-5 Area suitable for oil palm cultivation

Starting new plantations instead of investing in existing companies would provide several gains, but for the time span under consideration the start-up would be a too lengthy process. The gains would include the ability to control cultivation practices fully from the beginning. The project could also create valuable assets that would bring profit also in the form of appreciation. The time span to establish large scale plantations would, however, be long. The operations to be done prior to producing palm oil include: planning of the investment and financing; negotiations with land owners, seedling suppliers, logistics operators, suppliers of milling technology etc.; clearing the plantation area and building processing facilities, infrastructure; irrigation systems etc.; and finally planting the seedlings, waiting 2-3 years for the plants to start producing fruit. The economic production capacity (about 75 %) can be expected to be achieved 7 years after planting, but full production is not available until 10 years. Taking all these actions into account, greenfield projects cannot be considered as major feedstock sources during 2010-2015.

The time constraint leaves the acquisition of established palm oil companies as an applicable way to gain access to ownership of plantation and processing facilities. The emerge of new non-food raw-materials around year 2015 as the main feedstock for NExBTL would then direct Neste Oil to divest its stakes in palm oil production. Taking the divesting possibilities into account is an important aspect already when planning the investment. Factors that can affect the divesting are the performance of the company and future prospects.

The strategy of long-term contracts in Chapter 4.3 illustrated that palm oil production is concentrated to Malaysia and Indonesia. Other areas in the world are unable to provide such large quantities of palm oil that Neste Oil will require. Consequently, the companies to be acquired would operate in either or both of these Southeast Asian countries. Indonesian embassy in Finland confirms that today foreign investors are allowed to have full ownership of Indonesian palm oil companies. In contrast, Malaysian government has in past limited the ownership structure of companies to support the major population group of Malays. However, some exceptions to the limitations have been created to attract investments. Neste Oil's possibilities to utilize these exceptions would require further research. As in the case of long-term palm oil contracts, the cargoes could be delivered to any NExBTL facility around the globe if palm oil is financially competitive with local raw-materials.

4.4.2 FINANCIAL FACTORS

This subchapter introduces the expenses related to acquiring and running a palm oil division.

Costs of contracting

In contrast to sourcing from external suppliers, integration to palm oil production would help to lower transaction costs. Neste Oil's amount of control in the palm oil company is an important factor in determining how much negotiation is needed between NExBTL production units and the unit supplying palm oil. In the best case the transfer price between business units is fixed for long periods of time to stabilize the division of profits between the organizations. If the palm oil production unit were wholly owned by Neste Oil, the transfer price would not have effect on the performance of the whole company. However, having a partner in palm oil production changes the situation. The partner is interested in returns from its investment and transfer prices would have a major effect on how the investment pays off. Transfer prices are examined in the discussion on raw-material prices below. To achieve operational benefits from the integration Neste Oil should manage the product flow of the whole chain as centrally as possible. In practice this would mean having production planners of both the buying and selling organizations working together to plan deliveries to NExBTL plants and in some cases deciding on which lots should be sold out to markets.

Managing the relationship between a new palm oil subsidiary and the existing parent organization creates the settings for securing the sustainability of the raw-material. The two organizations should be able to work in close cooperation to transfer the sustainability requirements from end users to all operations in the supply chain. This is an aspect that could raise the costs as there is need for a unit to manage the sustainability of the operations in the whole supply chain. The target of the sustainability unit should be creating an uniform sustainability criteria and practices to be used in all plantations, mills and logistics processes. The creation of the criteria would be followed by enforcing the needed changes and controlling the results through audits. A major challenge in securing the sustainability is that the changes should be carried out practically overnight when Neste Oil acquires palm oil production capacity. The image of Neste Oil may get stained if environmental organizations bring problems into daylight when Neste Oil is still in the process of restructuring the culture of the palm oil division. Securing sustainability can be a massive project if there are hundreds of plantations to monitor. Thereby one point in the acquisition criteria should be that the cultivation practices are already very close to the wanted criteria to reduce the costs of the sustainability work.

Required investments

The acquisitions of established oil palm plantations and milling facilities requires large initial investments. A rough analysis of the values of nine palm oil companies in the end of 2006 shows that the median prices of Malaysian palm oil companies are USD 18 000 / mature hectare and Indonesian palm oil companies USD 16 100 / mature hectare. This is only an aggregate indicator of prices, but can be used to estimate the scale of required investments. The production of one million tonnes of palm oil requires roughly 200 000 mature hectares of oil palm plantations which accounts in Malaysia an investment of USD 3,6 billion and in Indonesia USD 3,2 billion. The strong palm oil prices have increased profit margins of palm oil companies and thus elevated their stock prices. Figure 4-6 graphs the indexed share value of five Malaysian publicly listed palm oil companies. The increase in the value of these companies ranges from 115 % to 211 % during January 2006 to June 2007, a period of just 1,5 years. For reference, Kuala Lumpur Composite Index, that includes also these companies, rose 52 % during the same period. It is notable that several of the companies in Figure 4-6 have stakes also in other businesses such as property development and rubber plantations.

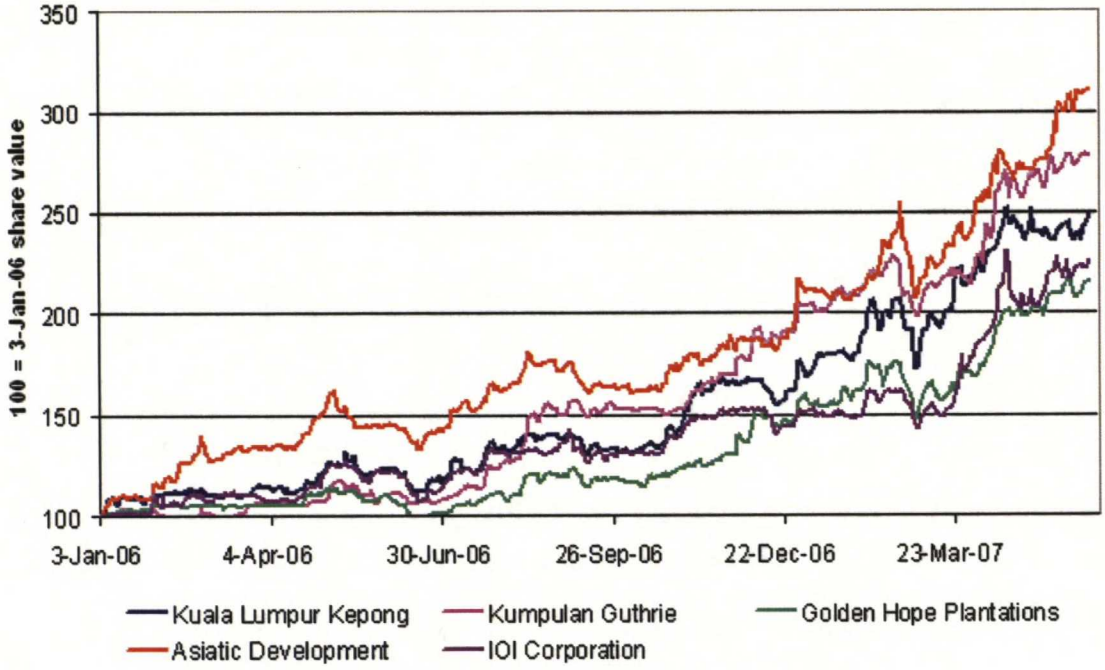

Figure 4-6 Palm oil company values 01/2006-06/2007 (The Star, 2007)

Divesting the palm oil division in 2015 contains threats. If the current high value of palm oil companies is based on the high raw-material demand for biodiesel production, the value may drop considerably when biodiesel producers move to alternative non-food feedstock. In case the intention of Neste Oil is to keep the oil palm plantations until there is a strong alternative to vegetable oils, the divestment would most probably happen at a time when the value of palm oil companies drops significantly. This could be managed to an extent by divesting the assets partially when the emergence of non-food feedstock approaches. In a whole, the strategy could be modernizing the sustainability standards of the acquired palm oil division, tying the unit to parent company with long-term contracts and then slowly withdrawing from the ownership.

Creation of a palm oil division would probably mean acquiring more than one palm oil company. To remain operationally efficient the acquired companies should be merged into one unit. In practice this would require several divestments to remove overlapping business operations and non-core businesses, but also investments in unified management and logistics systems. Non-core businesses for Neste Oil's palm oil division could include some of the common processes of current palm oil companies. Examples of these are production of oil palm seedlings, property development, rubber tree plantations and palm kernel processing units. Increasing the sustainability of

production would demand investments in physical assets. These assets may include infrastructure, machinery, housing, safety equipment etc.

Raw-material and logistics costs

Raw-material costs in the case of integrated palm oil production can be viewed as the costs of inputs at the oil palm plantations or the internal transfer price between the palm oil division and NExBTL production. In the following discussion, the focus is kept on the NExBTL production units and transfer prices. In general, buying palm oil from internal suppliers does not decrease raw-material costs. The possible benefits are protection from market price fluctuations, security in reaching long-term agreements with firm transfer prices, and ability to practice tax and customs planning to a certain degree. In addition to transfer prices, logistics costs occur.

Transfer pricing creates the possibility to internally measure the performance of different business units, but has also effects on the company wide performance. These effects are derived from the import and export quotas, value added taxes, taxes on profits and customs duties. Transfer prices can be determined in multiple different ways ranging from market price driven systems to practices using production costs as a basis. As the home countries of both the supplying and sourcing division are interested in receiving their fair share of profits in the form of taxes, OECD has introduced the Arm's Length Principle. The main idea of the principle is to keep transfer prices comparable to market prices to prevent multinational enterprises showing their profit in the unit operating in the country with lower tax rates (OECD Observer, 2002). Another important aspect from the taxation point of view is the avoidance of double taxation. In some cases, a trade between two countries may cause the taxes on profits to be paid in both countries for the same share of profit. Since this type of double taxation hinders international trade, many countries have agreed on bilateral policies to avoid double taxation. For example, Malaysia has made such an agreement with 52 countries including many European countries (Asia Trade Hub, 2007).

An important aspect in palm oil production is the type of oil to be produced. By investing in oil palm plantations and mills that process fresh fruit bunches into crude palm oil, Neste Oil would have access to oil that requires pre-treatment before NExBTL production. On the other hand, Neste Oil could invest in oil refining units that process the oil to finer products that do not require additional pre-treatment. This is an area that

requires further research if an integrated approach to source palm oil is chosen. The issue raises questions such as should the pre-treatment / refining be done centrally or at NExBTL plants and to what degree the oil should be refined. Determinants in the decision include the processing costs, logistics costs, secondary markets for raw-materials, taxes and customs duties, and also the value of the palm oil division as a whole in case it is divested around 2015.

The organization of the logistics system can be approached as in Chapter 4.3.3 where Figure 4-4 portrayed the possibility of using NExBTL plants as logistics hubs for palm oil streams. However, integrating NExBTL production with palm oil production offers possibilities also for advanced supply-chain optimization. Such possibilities could include joint research and development, for example, to produce crude palm oil that is more suitable for NExBTL production than the current. Open exchange of demand and cost information may open up possibilities to consolidate cargoes, reduce stock levels and re-engineer business processes to increase efficiency. This type of open information exchange is rarely possible in contractual relationships as both parties are reluctant to give away information that may weaken its position in future contract negotiations.

Risk management practices

Upstream integration can be seen as a risk management tool itself as one step of price risk is eliminated from the supply chain. However, in case Neste Oil integrates into oil palm cultivation the set of risks changes. Instead of being vulnerable to palm oil price risks, the integrated unit is dependant on the availability of production inputs in the first processing steps. In the case of palm oil, the inputs include workforce, fertilizers, seedlings and suitable cultivation conditions.

Investments in palm oil production could be used to hedge also the risk of NExBTL business value. The high price of palm oil has increased the profit margins in palm oil production and sent the values of palm oil companies soaring. If the correlation between palm oil prices and the value of palm oil companies works efficiently, declining NExBTL margins and business value can be hedged by investing in palm oil production. In other words, when the feedstock cost of Neste Oil increases and NExBTL margins weaken, the value of the investment in palm oil production increases.

As noted in the discussion about sourcing palm oil with long-term contracts, both Malaysia and Indonesia may experience natural disasters that hinder oil production.

Plantations' ability to produce fruit may fall, well-being of the workforce can be threatened and transportation of the products may experience problems. To manage the risks, the plantations and processing facilities can be dispersed geographically. On the contrary, geographic dispersion decreases economies of scale in transportation and management.

Ownership of assets contains several risks. ONDD (2007) estimates the risk of war in Indonesia to be low (2/7), but higher than in Malaysia (1/7). Risks of expropriation and government action are relatively high in Indonesia (5/7), which means that the government may take hold of the assets with low or no compensation. This is a serious risk if Neste Oil decides to invest in Indonesian palm oil production. In Malaysia the risk is low (2/7), but still existent. The third aspect of risks analysed by ONDD (2007) is the transfer risk that evaluates the propensity of events, e.g. authority interventions that prevent fund transfers such as repatriation of capital or payment of dividends. In Indonesia the risk is rated as medium (4/7) and in Malaysia low (2/7). In conclusion, government intervention or other adverse events are more probable in Indonesia than in Malaysia. The concentration of palm oil business to two developing countries creates substantial risks that are hard to manage. Local partners that have connections to governments may be able to create added security for the investment, but in the case of major changes, such as revolutions, the palm oil division could be in the danger of expropriation.

4.4.3 SCENARIO ANALYSIS

This subchapter uses the scenarios presented in Chapter 4.2 to discuss the effects of different future outcomes.

I. The global balance of vegetable oil supply and demand.

- **A.** The growth of vegetable oil demand outpaces the growth of supply
- **B.** The balance of supply and demand remains at its current state

Financial perspective

The financial attractiveness of investing in palm oil production is heavily affected by the development of palm oil division's value. In scenario A, the divesting value of oil palm plantations could develop positively. However, the original reasons of ownership may blur as the same scenario would mean substantial increases in palm oil market

value. If the price of NExBTL does not rise in tandem with vegetable oil prices, converting the oil to biofuel may turn out to be financially less attractive than selling palm oil to food producers. In this case, the ownership of palm oil production capacity works as a hedging tool against the loss of profitability in NExBTL production. In general, investments in palm oil production could be financially attractive in scenario A.

Realization of scenario B raises questions about how the value of palm oil production is going to develop. In this case there is no extraordinary upward pressure on palm oil prices and thus the divestment value of plantations is in danger if the demand for biofuel production drops. Scenario B would also mean that palm oil production increased substantially as well as the production of other vegetable oils. This may create pressure on existing logistics infrastructure and cause momentarily problems in finding storage space, stress shipping capacity and cause congestion in harbours. This is an aspect that may require investments from Neste Oil and may cause rising operational costs.

Feedstock security

Scenario A puts heavy pressures on palm oil availability. If Neste Oil integrates into palm oil production, it will create an environment where other large biofuel producers are also keen to seek control of the raw-material source. This will then create problems to further increase Neste Oil's palm oil production capacity. Further investments could be required if the raw-material demand increased faster than planned. The problems may rise from the pure availability of plantations and mills, but also from protectionist actions by local governments that may want to secure that the ownership of palm oil industry does not move totally to international players. Such government limitations may affect feedstock security also when Neste Oil has secured the control of sufficiently large palm oil production capacity. If the unavailability of palm oil causes starvation or the collapse of domestic biodiesel industry, Malaysian and Indonesian governments may see it necessary to limit the exports of palm oil products, especially unrefined crude palm oil.

In scenario B palm oil is generally available, but securing sustainably produced raw-material streams may be hard if the expansion of plantation area is carried out at the cost of tropical forests. Neste Oil's direct ownership in palm oil production would grant access to feedstock that has a controlled origin. To prevent surprises on sustainability,

planning the acquisitions would have to include careful auditions of the target companies and their operations.

Sustainability issues

Sustainably produced raw-material may turn out to be a good tool to distinguish Neste Oil from other palm oil based biofuel producers if scenario A occurs. The market of palm oil is in this case generally controlled by sellers and there might not be enough incentives for them to invest in sustainable cultivation practices. In such a market Neste Oil could be among those few that are ready to devote to western sustainability standards. In scenario A Neste Oil will remain among the largest palm oil producers and its differentiated cultivation practices may receive considerable media attention and thus help to build the green image of the company.

A serious problem that may affect both scenarios is the overall image of palm oil. In scenario B the rapid expansion of oil palm plantations may stain the whole industry. Simultaneously Neste Oil's share of the total production would decrease and cause problems to bring the sustainable cultivation practices into public attention. On the other hand, to keep the global market interested in palm oil, the producers may be forced to invest in sustainable production. Such a situation would be more likely in scenario B than in A since the demand would be in closer balance with supply. Compared to the possibility of standing out among other palm oil producers in scenario A, the different market environment encourages cooperation between palm oil producers to polish the image of the whole industry.

II. The existence of price premiums between different vegetable oils.

A. Different vegetable oils trade at substantial premiums compared to each other

B. The price gaps among vegetable oils become minimal

Financial perspective

As noted in the discussion about long-term palm oil contracts, scenario A may occur in two ways depending on whether palm oil is the least expensive vegetable oil or not. In the case where palm oil retains its current discount compared to other vegetable oils it is financially viable to use palm oil in NExBTL production. However, if palm oil trades at a premium compared to other vegetable oils, a dilemma arises. In the integrated palm oil strategy Neste Oil has the logistics and operations ready for sourcing palm oil in large

quantities to NExBTL plants, but prices may suggest that the oil should be sold out to markets and less expensive raw-materials bought instead. If there were no liquid markets for vegetable oils, producing the least expensive oil would be the best option financially. This could be the case if both, the biodiesel and food industry, were concentrated to the hands of few. If the markets are dominated by large players, the quantities trading at spot markets may be very small. At the moment, however, that is yet to be seen and consequently the opportunity cost, i.e. the cost of lost possibility, of trading the palm oil to markets exists. In case the market for vegetable oil exists and is able to absorb large quantities of oil, the strategic manoeuvres should be based on the vision of how the prices will move. If the situation is temporary, the occurrence of opportunity cost may have to be accepted, because changes in sourcing strategy would inflict considerable costs. On the other hand, if the market fundamentals change, for example by large scale drops in palm oil production, it may be attractive to change the sourcing strategy. It is notable that the situation is not very different from long-term contracts where Neste Oil is bound to a single raw-material and is not capable of instantly responding to market changes.

Scenario B could prove to be a complex situation if Neste Oil were involved in palm oil production. Minimal price gaps would encourage using local vegetable oils to minimize transportation costs, but at the same time Neste Oil would be committed to using palm oil as the main feedstock. In this case palm oil would be a natural raw-material for NExBTL plants in Asia, but expensive to use in other parts of the world. If the global market stabilizes to scenario B, it could turn out to be advisable to partly or fully detach from palm oil production. Such changes could be hard to carry out in practice in such a short period of time as 2010-2015. To benefit financially from raw-material flexibility, an optimal solution would be to tie NExBTL plants to the use of one feedstock only at times when it is economically advantageous. One way to create such a flexible situation would be incorporating large scale vegetable oil trading to own production so that the least expensive streams could be directed to own use. Otherwise, sudden movements from self-produced palm oil to purchased vegetable oils could be very difficult to arrange in practice.

Sustainability issues

Price changes could affect the figures of how much of Neste Oil's palm oil production goes into internal use, but the sustainability questions cannot be avoided by trading out

the majority of palm oil produced. Even though Neste Oil did not use palm oil in NExBTL production, as a palm oil producer it would still be a palm oil company and a target for sustainability critique. Another question is how the sustainability debate changes if scenario B occurs and western countries move to use less palm oil. On one hand, pressures on sustainable cultivation practices could decrease due to smaller media attention. On the other hand, if Neste Oil's competitors are not linked to palm oil, it leaves them the possibility to lobby against the use palm oil and bring out negative messages.

III. Neste Oil's raw-material demand for NExBTL production.

A. Neste Oil requires annually 1,5 million tonnes of feedstock

B. The demand for feedstock is 3,0 million tonnes annually

Financial perspective

The raw-material demand would be the main determinant of how much palm oil production capacity should be acquired. To keep the strategies of long-term contract sourcing and own palm oil production comparable, it is assumed that also in this strategy palm oil would cater 50 % of Neste Oil's raw-material demand. Thus the required amounts of palm oil would be 750 000 tonnes annually in scenario A and 1,5 million tonnes per year in scenario B.

By using the approximated values of palm oil companies presented in this chapter, scenario A would mean an investment of roughly USD 2,7 billion in Malaysia or USD 2,4 billion in Indonesia. For perspective, the current market value of Neste Oil is close to USD 9,5 billion (Kauppalehti, 2007). In case the investment was made in cooperation with another company, the required amount would be lower. However, if the target is to keep majority control of the palm oil company, the investment would still be several billions of US dollars. Scenario B would respectively mean acquisitions of double the amount, i.e. USD 5,4 billion in Malaysia and USD 4,8 billion in Indonesia. The investments would require further research to measure the financial attractiveness.

As noted in the discussion about sourcing palm oil with long-term contracts, large palm oil quantities are difficult to obtain from single companies. Only few Malaysian and Indonesian companies produce more than 500 000 tonnes of crude palm oil annually. Subsequently, the investment costs may be increased if Neste Oil has to acquire shares in multiple companies. Other problems that may occur are problems in merging

overlapping operations into single units and satisfying co-owners. Partners in joint ventures may find conflicts of interests if Neste Oil owns shares also in competing companies.

Larger palm oil production capacity could have economies of scale as discussed in this chapter earlier. On the contrary, managing a single unit that is responsible of cultivating 300 000 hectares as in scenario B may have its problems. Geographical and cultural dispersion of the plantations requires heavy bureaucracy to run the unit centrally, especially if the sustainability objectives are to be introduced to all plantations swiftly.

Feedstock security

Through the integration to palm oil production Neste Oil could secure a major part of its feedstock supply in both scenarios A and B. To reach a position where Neste Oil produces large quantities of palm oil, the acquisitions should be carefully planned and carried out in a dynamic manner. The acquisition process could turn against itself if other large users of palm oil heard about Neste Oil's plans and felt forced to integrate upstream as well. Rumours about Neste Oil's integration plans could lead to bid wars of palm oil companies and push the investment costs up. In addition, a sequential integration process, where Neste Oil increases its investment in palm oil production in small increments, may cause a trend of upstream integration where reaching high production volumes turns out to be difficult. The new market could consist of few integrated players and thus make it difficult to secure the rest of the required feedstock quantities with further investments or through contracting.

Sustainability issues

Implementing sustainable cultivation and processing practices to large plantations requires serious effort. Currently the approach to sustainability issues varies among palm oil producers. Most of the large palm oil companies in Malaysia and Indonesia recognize the need to build a sustainable image to attract demand from European and North American customers. Some companies have introduced "zero-burning" measures to clear aged oil palm plantations, increased investments in housing of the workforce, provided possibilities for the children of the workers to obtain proper education, and found alternative measures to manage the pests at plantations. Milling operations have faced development in the use of mill effluents, e.g. in electricity production, and in processing empty fruit bunches to be used as fertilizer. On the other hand, some of the

major companies have taken the approach that non-governmental organizations are spreading misinformation in Europe and the operations are already done sustainably. They work on the issues by spreading counterarguments against false claims. The third group consisting of small players in palm oil production are left outside the whole sustainability agenda. They do not have the resources to work in organizations such as Roundtable on Sustainable Palm Oil and to implement changes to the current practices. Most of all, they are rarely in direct contact with western customers and thus do not have any special incentives to manage sustainability.

In scenario A, the needed plantation area is around 150 000 hectares which can be acquired either by investing in a currently large palm oil producer or consolidating several smaller players into a single unit. Sustainability work with large players could be easier to initiate if the company had already a certain level of unified practices between plantations. Creating sustainability standards for a unit consisting of several small companies may be problematic, even though the lack of sustainability criteria could decrease the value of target companies and thus result in lower investment costs. The problems that Neste Oil could face on the sustainability front are depletion of rainforests from the way of new plantations, clearing forests and old plantations by burning, driving species into extinction through the loss of biodiversity, depriving aboriginal people of their way of life, conflicts over resources, discrimination of smallholders, corruption, hazardous and poor working conditions, the use of environmentally dangerous fertilizers and pesticides, and the utilization of child labour.

Scenario B and 300 000 hectares of mature plantation area is hard to obtain without the acquisition of multiple companies. The workload to certify the sustainability of hundreds of individual plantations could turn out to be daunting. A typical change process starts by setting the objectives, auditing the targets of development, and determining the needed measures. After the preliminary work is done, the actual changes are implemented. The results of the changes have to be supervised and controlled periodically. In the worst case, the preliminary and controlling audits could take years to carry out. To avoid the micromanagement of the typical certification process, the "command and control" approach should be abandoned. Instead, the organization should be built so that it controls itself. An example could be communicating the sustainability criteria from the top to the bottom in the organization, but creating incentives for the plantation workers to ensure that the changes are truly

carried out. This way the control would work from the bottom to the top. However, to receive external accreditation, audits would still have to be carried out.

4.5 STRATEGY 3: ACQUIRING SOYBEAN CRUSHING CAPACITY

Integration to soybean crushing would not be a natural step for a biofuel producer to take since the oil production has been traditionally a side business for soybean crushers. The main product from soybeans is the meal that is mostly used as animal feed. However, the increasing vegetable oil demand may change the market fundamentals as the rising price of soybean oil raises the importance of oil sales in crushing business.

In general, gains that can be sought by upstream integration include financial benefits, raw-material security and certified sustainability of the feedstock. Involvement in soybean crushing provides limited help to these matters. Instead of taking control of the whole upstream chain, the integration would only move the company border one step further upstream. The main gain that could be achieved is increasing the control in what seeds are used to produce the oil. This chapter analyses how the integration could be done and what kind of results it may have in different future outcomes.

4.5.1 SOYBEAN CRUSHING FOR NEXBTL PRODUCTION

As Table 4-3 shows, world soybean production is concentrated to America. China and India both produce a significant amount of soybeans, but their increasing domestic animal feed and vegetable oil demand has made them net importers of soybeans. Consequently, the soybeans Neste Oil could use for oil extraction and then further for NExBTL production would most probably have to be sourced from USA, Brazil or Argentina.

Table 4-3 Soybean top-5 producers in 2005 (FAOSTAT, 2007)

Soybeans	*tonnes/a*
World total	212 588 000
1. USA	83 368 000
2. Brazil	51 182 000
3. Argentina	38 300 000
4. China	16 800 000
5. India	6 300 000

Neste Oil's soybean crushing plants could be located either close to the origin of soybeans, in logistics hubs such as harbours or near NExBTL plants. As noted in Appendix B, soybeans can be stored up to 18 months without any changes in bean quality. Consequently, the location of the crushing plant is not limited by the source of beans as in the case of palm oil. Also soybean oil can be transported globally and thus the use is not limited to NExBTL units in certain areas. Logistics costs favour NExBTL production units in North and South America.

An important determinant in the location question is the handling of the meal business. By building significant amount of soybean oil production capacity, Neste Oil would become a large producer of soybean meal as well. As the meal business is relatively far from Neste Oil's core businesses, a solution could be outsourcing the whole meal business. A partner could be responsible for marketing and transportation of the meal and thus enable Neste Oil to concentrate on the oil business. The problem in this arrangement is the financial aspect. Most of the revenue for a soybean crusher is created by the meal sales and thus controlling the meal business may be seen as the core competence of a regular crusher. In case the meal side of the operations is left for less attention, it may affect adversely the financial performance of the whole company.

The question of whether a single plant should be built or bought is not limited by time constraints if the target is to have the crushing plant operational in 2010. The building process is eased by the fact that soybean milling and refining use readily available technology. Machines can be bought with a lead time of less than one year and as the facilities can be built during the same time, the actual build time would probably be under 16 months. Allowing 8 months for pre-feasibility studies and plant design, the whole project could be accomplished in approximately 2 years. However, if soybean oil is to be considered as the main feedstock for all NExBTL plants, a single crushing plant provides insufficient output. A common crushing plant in USA produces 140 000-200 000 tonnes of soybean oil per year (Li et al., 2003), while the largest plants in the world reach figures around 500 000 tonnes per year. Building large or multiple soybean plants could be difficult to carry out in a rapid schedule.

Acquiring existing crushing plants could be a feasible strategy in North America, where the industry giants have been restructuring their plant network in the recent years. For example, during 2000-2003 ADM closed eight crushing facilities in USA due to weak crushing margins (Li et al., 2003). The trend in soybean crushing is moving towards

processing in low cost countries such as China, Brazil and Argentina. Getting hold of existing capacity in these countries could be possible by acquiring an established soybean processing company whereas in USA only few smaller players exist on the side of global conglomerates.

4.5.2 FINANCIAL FACTORS

This subchapter introduces the expenses related to acquiring and running soybean crushing capacity.

Costs of contracting

Integrating soybean crushing to the NExBTL production process could increase the transaction costs considerably compared to purchasing soybean oil. Instead of negotiating with few large vegetable oil suppliers, the feedstock purchases would be made from a more scattered group of farmers and traders. Consequently, the number of contracts in soybean purchases would be larger than in soybean oil purchasing. The small transported lots are visible also in the operational side of soybean crushing. Sourcing soybeans from inland sources means that the available modes of transportation are mainly barges, trains and trucks. If the location of the crushing plant cannot be reached by barges, the number of railcars and trucks may rise to very high figures since, for example, a plant that produces 500 000 tonnes of soybean oil per year receives on average over 7000 tonnes of soybeans daily. Even though the meal sales were outsourced, the high quantity of meal produced would apply pressure on logistics coordination.

Managing the relationship between the NExBTL organization and soybean crushing units depends partly on how they are located. If the soybean crushing units are placed at NExBTL plants, a logical entity to manage is created. The entity works as a single unit using soybeans as part of the feedstock and outputs soybean meal and NExBTL renewable diesel. If the plants are located separately, the need for management resources is higher. Coordinating the operations between two separate facilities requires centralized supervision and the possibilities to use same local management resources for both operations are smaller. Based on these assumptions on needed management resources, integrating soybean crushing to NExBTL units could bring economies of scale in management as well as in operations coordination.

Required investments

The required investment to enter soybean crushing can be approximated by taking a look at several recent plant projects. One reference price for a crushing and refining unit in USA can be found in Carlson's (2006) study. The planned processing unit capable of producing 156 000 tonnes of refined and bleached soybean oil per year represents an investment of USD 75 million. The price is high compared to Bunge's investment in soybean crushing and oil refining facility in Council Bluffs, Iowa. Li et al. (2003) reported that the investment of USD 100 million brought Bunge crushing and refining capacity to produce 410 000 tonnes of oil per year. The comparably sized project of Novoye Sodruzhestvo in Russia was projected to cost USD 100 million as well (Desmet Bellestra, 2005). The entity has a planned oil output of 500 000 tonnes per year, a sea terminal and large warehouse facilities. For further comparison, Cargill invested in 2006 USD 60 million to build a soybean crushing plant in China. The capacity of the plant is 350 000 tonnes of oil per year. The same project can be used also as a reference for the build time as the venture was completed in 15 months (Cargill, 2006). On the basis of the above mentioned large scale projects, it can be concluded that to produce million tonnes of soybean oil per year would require investments in several plants worth a total of USD 200-300 million.

As the scope in this analysis remains in the limited period of 2010-2015, the divestment of soybean crushing units represents an important question. An event triggering the withdrawal could be unbearably low crushing margins or the movement to non-food raw-materials. In such a situation selling the soybean processing capacity is a natural option, but the processing plants could also be kept in operation in the new circumstances if they were so called multi-seed plants. Soybean processing units can be initially built or converted so that they can process also other seeds than soybeans. This type of units could facilitate movement to crushing non-food seeds such as Jatropha, Pongamia or Castor seeds. However, producing oil from non-edible seeds would most probably cause limitations in moving back to edible seeds because of the possible meal contamination. As a benefit already before using non-food seeds, the multi-seed crushing units could produce oil from rapeseeds and sunflower seeds in addition to soybeans. This would preserve part of the raw-material flexibility despite the integration to upstream processes.

The actual divestment value of a soybean crushing facility depends heavily on the attractiveness of its soybean meal production capacity. In the recent years the low crushing margins in USA have caused closures of multiple plants (Li et al., 2003). The production seems to concentrate to fewer large plants that can by economies of scale be profitable also in difficult market conditions. As a result, to maximize the divestment value in USA would require the plant to have a logistically favourable location and to be able to process a relatively large amount of soybeans per year. Divesting the plant in a country, where soybean crushing is in uptrend, could be easier than in USA. However, it is unclear how the capacity develops in the future in current growth areas such as China, India and South America.

The divestment value depends also on the possible oil refining capabilities of the plant. While NExBTL production does not require food quality soybean oil, the refining unit could be a valuable asset at the time of divesting the plant. As reported in Appendix B, oil refining is currently an important part of crushers' operations as food processors rarely have their own refineries. Consequently, a minimum requirement for the crushing plant would be that it is located at a site that has enough space for a refining unit even if the plant is designed to produce only crude degummed soybean oil. A refining unit could have use also when producing NExBTL since the oil would not then require pre-treatment at the NExBTL plants. If the refining unit is able to produce food quality oils, it would also open secondary markets for the oil, the food processors.

Raw-material and logistics costs

Raw-material costs can be viewed as the transfer price between soybean oil production and NExBTL plants or as the costs of inputs at the crushing plant. As noted in Chapter 4.4.2, the transfer price between overseas vegetable oil production and NExBTL units has to be close to market prices to fulfil the requirements of OECD Arm's Length Principle. The following text leaves the transfer costs aside and concentrates on the characteristics of soybean crushing costs.

In the integrated position Neste Oil would be subject to the volatility in soybean prices and soybean meal prices. For comparison, in the contractual buying position the price volatility would come only from the changes in soybean oil prices. If the soybean processing costs are kept fixed, the two situations can be compared from the purchasing point of view. Figure 4-7 presents the variation of the costs in the two cases. The prices

are derived from Chicago Board of Trade quotations and have been adjusted by the needed feedstock quantities. In practice this means that a crusher has to purchase 5,3 tonnes of soybeans to produce a tonne of soybean oil. The crusher, however, can sell the resulting meal to cover part of the soybean costs. The respective meal content is 3,8 tonnes.

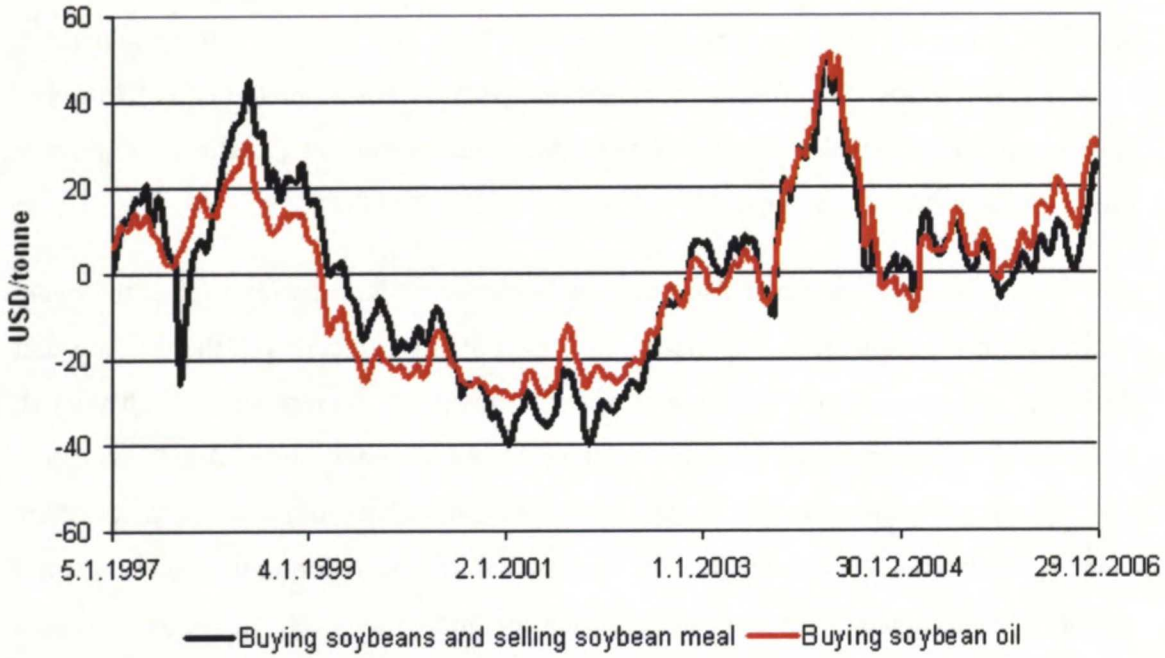

Figure 4-7 Impacts of market prices to soybean crushers and purchasers (CBOT, 2007)

As the figure shows, the variation of the costs is very similar in both situations. The standard deviation of soybean oil cost is slightly smaller than the standard deviation of crusher's soybean costs and soybean meal revenues. This study indicates that integrating to soybean crushing does not provide protection from soybean oil market price fluctuations. The situation may change in the future if the price of soybean oil becomes the main driver of soybean prices. If the same approach as in Figure 4-7 is used and soybean price changes are artificially linked to soybean oil prices without altering soybean meal prices, the variation of crushers costs increase. However, the real effects are hard to estimate as the link between soybean meal prices and soybean prices in the future is unknown.

As noted in the text previously, soybean crushing is a low margin business. Neste Oil's involvement in crushing does not help to lower the raw-material costs of NExBTL production and reductions in feedstock price volatility are questionable. The gains from upstream integration could in this case be sought from the feedstock traceability by

dealing directly with soybean farmers. The problems in sustainability may be in the use of genetically modified soybeans that have import restrictions to EU or in cultivation practices, especially in South-America. In Brazil expanding soybean plantations may pose a threat to tropical forests and the environmental effects of cultivation may be less controlled than in USA. The problem in dealing directly with the farmers is the high transaction costs due to the high number of suppliers. If this is to be avoided, the only option is to buy readily consolidated cargoes from warehouse keepers such as grain elevators. However, as the beans from different sources are mixed in warehouses, it is hard to trace the origin of the raw-material.

The logistics solutions to transport soybeans and soybean oil can be managed in multiple ways. One of the key determinants is the locations of soybean crushing plants. If they are located at NExBTL units, the main considerations are in the inbound logistics of soybeans. A NExBTL unit that is located close to soybean farms could be able to source profitably part of its raw-materials directly from local farms. However, to produce raw-material for a plant that outputs 500 000 tonnes of soybean oil annually, the cultivated area has to be around one million hectares. As the required feedstock quantity is this large, at least part of the input would have to be sourced from remote locations. In such a case, traceability of the soybean origin would require Neste Oil to be involved in the grain elevator step of the supply chain as well.

The involvement in soybean storing could have several effects. It would allow Neste Oil to actively trade soybeans as well as source beans with a certified origin to own crushing units despite the location of the crushing facility. As discussed above, crushing plants that are located at NExBTL units could be hard to divest in case they do not provide any value in processing non-food feedstock. To avoid such a situation, a crushing plant located by the constraints of food oil processors and meal customers could be a better option. In such a case the logistics would have to cover also the transportation of soybean oil to NExBTL plants. This could lead to higher stocks in transit and need of higher buffer stocks of soybean oil at NExBTL production units. On the other hand, the separate soybean crushing plants could be sized more optimally according to the local raw-material availability and multiple plants could be used to serve a single NExBTL unit.

Risk management practices

In Chapter 4.4.2 it was noted that the investment in palm oil production provides hedging value against the fall of profitability in NExBTL production. On the contrast, investing in soybean crushing does not provide such value. A high price of soybean oil has a substantial effect on the profitability of NExBTL production, but smaller effect on the profitability of the soybean crusher as only about 40 % of the crusher's revenue comes from the oil. However, the fundamentals may change and create hedging value if the price of soybean oil increases significantly compared to soybean meal price.

Price risks can be hedged through various derivative markets. In the integrated position Neste Oil would be vulnerable to price risks of soybeans and soybean meal. Derivative markets for soybeans and its products are available in several global locations, but one of the most important exchanges is Chicago Board of Trade (CBOT). CBOT offers futures and option instruments for soybeans, soybean meal and crude degummed soybean oil. Soybeans are further divided into North and South American markets with different physical delivery points and soybean specifications. CBOT derivatives for soybeans and its products can be considered liquid for a year ahead, but most of the traded volume is concentrated to contracts one, four or five months forward.

The importance of the meal business in soybean crushing carries significant risks. In addition to market price risks, the relatively low investment in building a crushing plant may attract competition. The large global players ADM, Bunge, Cargill and Louis Dreyfus may with their actions easily distract Neste Oil's possibilities to sell the meal out and thus increase the feedstock cost of NExBTL production. To counter this risk, a strong partner that handles the meal sales could prove to be valuable. On the other hand, some of the agriculture conglomerates are involved in biofuel markets and are thus possible competitors of Neste Oil. Letting a competitor to control the meal sales carries its own risks that are harder to manage.

4.5.3 SCENARIO ANALYSIS

This subchapter uses the scenarios presented in Chapter 4.2 to discuss the effects of different future outcomes.

I. The global balance of vegetable oil supply and demand.

A. The growth of vegetable oil demand outpaces the growth of supply

B. The balance of supply and demand remains at its current state

Financial perspective

Profitability of soybean crushing is highly dependant on the market prices of soybeans, soybean oil and soybean meal as well as costs of processing. Compared to palm oil production the whole picture is more complicated due to the high value of the meal component.

Scenario A would mean that soybean oil price strengthens and increases the importance of the oil component in soybean crushing. When the price reaches a certain level, soybean quotations will follow the changes in soybean oil price more than the variations in meal price. Still, in such a case much of the profitability depends on soybean meal demand. If meal demand is high compared to supply, also the prices of soybeans feel upward pressure. However, the crushing margins are not bound to change without the entire soybean business restructuring itself since both, the product and raw-material prices, would soar concurrently. On the other hand, if the meal demand does not spike like soybean oil demand, the price of meal may decelerate the rise of soybean prices. In such a case soybean crushing margins may see a lift and profitability increase. However, very high increases in soybean oil price may cut the decelerating effect of meal prices. A third case that may occur is that the soybean supply responds aggressively to the rising soybean oil demand and creates oversupply of meal as a side effect. If scenario A still occurs and demand of vegetable oils still outpaces the growth of supply, low meal value may keep the prices of soybeans under control. In this case the margins of crushers will probably remain stagnant.

The situation in scenario B would mean that the supply of soybean oil would rise substantially among other vegetable oils. First, the cultivated area would have to increase considerably to increase soybean production. Second, the crushers would have to respond by increasing crushing capacity. This could lead to a situation where there is momentary lack of crushing capacity. The imbalance could strengthen crushing margins for a period. But then again, the meal component determines half of the success and makes the margins hard to predict. As speculated in scenario A, a rise in soybean

production due to the rising oil demand may result in oversupply of soybean meal and consequently decrease the revenues of crushers.

In general, it is hard to see the crushing margins to soar in either of the scenarios above. The lack of crushing capacity may create temporary spikes in margins, but in the end the extra revenue from rising product prices is transferred to soybean suppliers. The bottleneck in long term is in the cultivated area instead of the crushing capacity. However, grain elevators have an important role in controlling the bean supply. Accordingly, they would probably be able to capture a slice of farmers' increased margins. As a consequence, investments in sole crushing are unlikely to increase Neste Oil's profitability.

Feedstock security

In scenario A, the shortage of soybean oil would increase the demand of soybeans. In such a case being a soybean crusher does not provide much additional value to purchasing soybean oil by contracts. On the other hand, single farmers are not able to control the availability of soybeans to a large extent as they usually lack the warehouses and transportation needed to change the destination of their seeds. In such a case, the role of the gatekeeper may be held by the unit consolidating soybean streams from farmers. To achieve such a role, Neste Oil would have to be involved in grain elevators and source the feedstock directly from farmers.

Scenario B could mean that the feedstock security is not such a vast problem for soybean crushers in global scale. However, a shift of production from one area to another may create immense problems for a crusher that relies on the availability of local feedstock. If a company decides to start soybean crushing for instance in central USA, problems may arise if masses of domestic farmers are tempted to change to cultivate another crop instead of soybeans. An inland processor can hardly operate efficiently using imported soybeans. To summarize scenario B, upstream integration to soybean crushing has potential only to decrease feedstock security.

Sustainability issues

Soybean cultivation creates sustainability problems through the extension of cultivated area and cultivation practices. The hot topic in farmland expansion is the conservation of forests and grasslands in South America, which is also one focal point of the WWF

driven Round Table on Responsible Soy (RTRS, 2007). Deforestation threats the biodiversity in rainforests, such as Amazon, but also in other virgin areas. The problem is magnified by the effects following farming. Increased transportation justifies the improvement or construction of infrastructure which attracts also other investments, for example in the fields of logging, mining and ranching. The problems in actual cultivation include water pollution, soil erosion, social conflicts and tension between producers and local communities (RTRS, 2007). Critics of genetically modified (GM) soybean species (e.g. Altieri & Pengue, 2006) hold the modified beans responsible for many of the problems. Such issues are expansion of farmland to highly erodible lands and the increased use of fertilizers, herbicides and pesticides, which may in turn cause land contamination.

The whole sustainability aspect of soybean cultivation is difficult to judge. Some environmental organisations are pushing against GM soybeans, but on the other hand genetic modification of food crops has its positive sides as well. The same amount of land can produce more food than with regular soybeans and may bring wealth to poor areas by more efficient cultivation. In addition, some environmental non-governmental organizations have indicated that GM soybeans may be a better choice for biofuel production than normal soybeans in terms of energy balance. Prior to using soybean oil in NExBTL production, Neste Oil should take a clear position regarding genetic modification in its sustainability criteria for soybean production.

In both scenarios, A and B, avoiding GM soybeans could be very difficult. However, being involved in soybean markets may open doors to control the raw-material source to a higher degree than as a purchaser of soybean oil. In scenario A the pressures to increase soybean yields are high and GM soybeans offer a fast way to higher revenues. In an environment where supply is scarce, finding GM free feedstock may be difficult and cause that at least part of the supply has to be GM beans to keep the crushing plant running at a reasonable utilization rate. If the technical use of genetically modified soybeans does not meet resistance from NExBTL markets, Neste Oil as a soybean crusher in scenario A could be able to satisfy the feedstock demand with highly priced, but sustainably produced soybeans. It should be noted that even though the sustainability of GM soybeans is unclear, banning their imports provides an easy way for governments to protect domestic oilseed production.

Scenario B represents a future outcome where the cultivated area of soybeans would have increased significantly. The expansion would probably cause depletion of forests as well as other sustainability problems. In practice this would mean that there were both sustainably produced and less environmentally friendly soybeans available. In such a case direct contact with farmers could prove to be the only way to acquire soybeans with an acceptable origin. If a single sustainability certification system emerges, the certified soybeans can trade at a premium compared to other beans. This would require keeping different kinds of soybeans separated throughout the supply chain and stress especially warehouse operators such as grain elevators.

II. The existence of price premiums between different vegetable oils.

A. Different vegetable oils trade at substantial premiums compared to each other

B. The price gaps among vegetable oils become minimal

Financial perspective

Currently soybean oil trades at a premium compared to palm oil, which also represents a possible position in scenario A. From NExBTL producer's point of view the situation would be two folded. In the global scale it would be less expensive to use palm oil as the main feedstock, but logistics costs could make local raw-materials more attractive. Integration to soybean crushing does not change the situation much, as only the sourced feedstock is changed from soybean oil to soybeans. If soybean oil were not the least expensive largely available feedstock, it could still be a financially viable raw-material for NExBTL plants in North and South America. This would be the case especially if American governments heightened import barriers for foreign vegetable oils, exporting countries of other vegetable oils feel pressure to limit exported quantities or overseas logistics costs increase substantially.

Scenario A includes also a situation where soybean oil would trade at a discount compared to other major vegetable oils. Such a situation could be created temporarily if the currently less expensive palm oil experiences severe production problems, for example a crisis in South-East Asia. However, as many of the vegetable oils are substitutes to each other, the crisis would shortly reflect to the price of soybean oil. A cause to a longer term discount could be a considerable increase in the demand and supply of soybean meal and consequently increased soybean oil production. In this case soybean oil could be a strong candidate to become the main feedstock for a number of

NExBTL plants. However, in either of the scenario A cases upstream integration would not provide any special financial benefits compared to being a purchaser of soybean oil.

In scenario B, integration to soybean crushing would not be enough to justify the use of self-produced soybean oil at overseas NExBTL plants if local oils are available at the same price. Using local vegetable oils would be wiser to avoid high transportation costs and to strengthen the company image in the production area. The situation is somewhat different if the commodity transported overseas is soybeans instead of soybean oil. Global differences in meal prices could make it profitable, for example, to ship soybeans from South America to Europe for crushing and meal trade. If such scheme is not financially viable, the crushing plants in Europe could be kept running with local oilseeds if the plants were designed to be able to process multiple types of oilseeds.

In summary, integration to soybean crushing would not create any financial benefits in either of the scenarios. Integration to crushing would limit the number of possible raw-materials and thus cause additional expenses in cases where other vegetable oils trade at discount compared to soybean oil.

Sustainability issues

One special case of scenario A occurs when a single commodity market is divided into products selling at different prices. As noted in previous variable, such a case may emerge if the market distinguishes sustainably produced soybeans from non-sustainable beans. Currently the division is created to some extent by the possibility to buy either GM or non-GM soybeans. It would not be unthinkable that the distinction between these two categories extended to cover also other criteria such as the overall cultivation environment and chemicals used in production.

If the markets start to separate sustainable and mixed soybeans, being a soybean crusher could be beneficial from the sustainability point of view. Purchasing certified soybeans could be easier than sourcing oil that is produced from the specific seeds. This would be the case especially before the sustainability criteria becomes widely accepted, because keeping small lots of special soybeans segregated from other seeds through the whole supply chain could be very difficult and unprofitable for warehouse keepers, crushers and shippers. However, as noted in the text above, controlling the seed origin would require Neste Oil to be able to deal directly with farmers.

III. Neste Oil's raw-material demand for NExBTL production.

A. Neste Oil requires annually 1,5 million tonnes of feedstock

B. The demand for feedstock is 3,0 million tonnes annually

Financial perspective

In the strategies discussed in previous chapters the share of the main feedstock has been assumed to be 50 % of all raw-materials. To keep the strategies comparable, the same share of the main feedstock is used as a starting point in this analysis. In practice, using soybean oil as the largest single raw-material for all NExBTL plants would be unlikely. NExBTL production units in Asia would have freight advantage in using palm oil which, in addition, has rarely been more expensive than soybean oil. Thus using soybean oil there in large quantities would be hard to justify financially.

In scenario A, investing in crushing plants capable of producing 750 000 tonnes of soybean oil annually would require building or acquiring multiple crushing plants. Based on the information in Chapter 4.5.2, two large crushing plants being able to produce a total of 800 000 tonnes per year would require an investment around USD 200 million. The two plants would produce combined over 3 million tonnes of soybean meal per year. By the average CBOT price of the first quarter in 2007, the value of the meal would be USD 710 million. The high value compared to initial investment suggests that the financial aspect in crushing business is dominated by the competence to purchase low-cost soybeans and trade the meal out profitably. Applicability of scenario A would be highly dependant on whether Neste Oil sees that soybean and soybean meal trading can be done profitably or not. The largest problems may turn out to come from the market entry to meal markets. As stated earlier, the meal markets are dominated by the few conglomerates and as a consequence the mature meal markets have high entry barriers for newcomers. One possible route to use is outsourcing the sales of the whole meal component to such conglomerate. However, outsourcing soybean crusher's main source of revenue carries its own risks.

Scenario B views Neste Oil as a producer of 1,5 million tonnes of soybean oil annually. In practice this would need an investment in 3-4 large soybean crushing plants or many smaller ones. The approximated investment would move around USD 400 million and respectively meal sales from USD 1,3 billion to USD 1,4 billion annually depending on the specific capacity. USDA (2007) reports the world soybean meal production to be

153 million tonnes in 2006. Crushing capacity in scenario B would output 5,8 million tonnes which would account for 3,8 % market share in the world. If the plants were located in USA, we can compare Neste Oil's crushing capacity to the largest players by using data presented by Carlson (2007). Table 4-4 has been calculated from the active crushing capacity of the companies by converting bushels per day -capacities to metric tonnes per year figures. The meal and oil yields have been based on the extraction rates presented in Appendix B.

As Table 4-4 shows, by investing in soybean crushing in large scale in USA Neste Oil would become one of the largest soybean crushers locally. It is notable that the established players have a relatively high number of plants which means that the average oil outputs of single plants are below 200 000 tonnes per year. Geographical dispersion of processing facilities helps to reduce transportation costs of both the raw-materials and end products if the products are consumed mainly locally.

Table 4-4 Soybean crushers in USA, tonnes per year (Carlson, 2007)

	Crushing plants	Soybeans processed	Meal production	Oil production
ADM	14	14 100 000	10 300 000	2 700 000
Bunge	13	13 200 000	9 600 000	2 500 000
Cargill	12	10 800 000	7 900 000	2 000 000
Neste Oil	-	***7 900 000***	***5 800 000***	***1 500 000***
AGP	9	6 200 000	4 500 000	1 200 000
All others	-	*9 800 000*	*7 200 000*	*1 900 000*

To summarize the financial effects of both scenarios, the importance of meal sales is very high compared to investment costs. Profitability of the whole investment in upstream integration relies heavily on Neste Oil's ability to handle the meal component.

Feedstock security

Upstream integration to soybean crushing has limited potential in securing feedstock availability in both scenarios. Purchasing soybeans from large players does not differ much from purchasing soybean oil. In addition, the partner in both cases may be the same vertically integrated agricultural conglomerate. To create additional security, Neste Oil would have to be in direct contact with the farmers producing soybeans. The contact could be built by integrating into soybean elevators or by using small scale soybean crushing units that can rely on local feedstock availability. The security would

develop if Neste Oil could build long lasting relationships with farmers that are ready to commit to cultivating soybeans for several consecutive years. Building such relationships is difficult since farmers are likely to optimize their revenue by following market prices of different crops and using crop rotation to manage the soil quality and pest issues.

Sustainability issues

The quantity of soybeans sourced has a direct effect on managing the sustainability issues. As the raw-material need increases, the number of suppliers increases and controlling the origin becomes gradually more difficult. Alexander et al. (2006) categorize soybean farms in Indiana to be large if they cover at least 1000 acres and small if they cover 500 acres or less. Using 1000 acres (roughly 400 hectares) as a reference point we can approximate the number of suppliers for plants in scenarios A and B. The expected yield of a soybean farm is calculated from USDA (2007) production data and based on USA statistics. The projected yield is 0,535 tonnes of oil per hectare.

In scenario A the plantation area would be around 1,4 million hectares, which is 3,5 million acres. Consequently, the number of farms would be 3500. In such a case auditing all the farms and tracing the origin of single shipments would be extremely difficult. Scenario B would make things even more complicated. In practice, the only way to enforce compliance with Neste Oil's sustainability criteria would be by using the criteria as a prerequisite for the supply contract. Controlling the farms would require random checks to be carried out continuously.

The high number of farms raises the question of whether the task of controlling the sustainability could be eased by integrating into soybean cultivation. Due to the distinctive farming features of soybeans, the strategy would be immensely more complicated than integrating into oil palm cultivation. First, the successful farming of soybeans would require crop rotation and thus take Neste Oil to other businesses as well, for example corn cultivation. Second, whereas oil palms occupy the ground for tens of years, profitable soybean production requires seasonal financial judgement of the crop to be planted. If Neste Oil has to stick to soybean cultivation even when the market prospects are low, the cultivation has a negative effect to the result of the whole company. Third, the cultivation costs of soybeans are high and oil yields low compared

to oil palm. Fourth, the soybean farming business, especially in USA, is traditionally run by independent farmers. The entry of a large foreign conglomerate to the business would be probably opposed wildly and governmental barriers set.

4.6 SUGGESTIONS

This chapter presents the author's view on how Neste Oil should proceed with its strategy regarding raw-materials of NExBTL production. The following discussion suggests specific strategies that could be used in certain future outcomes. However, it is important to note that even though the strategies may be attractive in specific scenarios, quantitative analysis of the investments and costs involved are crucial. In other words, the following step for Neste Oil is to select strategies for further calculations. As in the previous text, the focus in this chapter remains in the period prior to the large scale availability of non-food raw-materials. In practice the scope is in 2010-2015.

Chapter 4.6.1 discusses the viability of upstream integration as a sourcing strategy for Neste Oil. The following chapter (4.6.2) selects preferable strategies for different future scenarios.

4.6.1 UPSTREAM INTEGRATION

The strategic consideration of the make-or-buy question is summarized below based on the case study. The question of whether to outsource or not can be divided into three divisions. (1) Is upstream integration financially attractive? (2) Is controlling the feedstock source critical for the end-product to succeed? (3) Is there acceptable raw-material available in open markets?

(1) Is upstream integration financially attractive?

As noted in the analysis of the three specific strategies in the previous chapters, integration to upstream does not decrease raw-material costs at the NExBTL production step. The transfer price between feedstock production and NExBTL production merely determines where the added value of the product is shown. In practice, the raw-material cost can be increased due to the loss of flexibility to use the least expensive vegetable oil or animal fat.

Transaction costs that arise from negotiating with contract partners can be decreased by upstream integration. In an optimally organized integrated situation the transfers

between the two internal divisions are handled centrally. This reduces the need to negotiate the transfer price and to coordinate financial matters between the divisions. In practice, strong central coordination is difficult in a global organization and would in turn increase management costs. Involvement of the management is needed to align the incentives of the buying and selling organization to optimize the result of the entire company. On contrast, in an outsourced position the open markets create the incentives for both organizations.

Large scale financial benefits can be created only in several indirect ways that require further research. First, the investment in upstream operations can have a high rate of return compared to its risks. The high rate of return may result from profitable operations and increased value of the investment. Determining the present value of a strategy requires calculating the specific investments to companies or projects. Second, the investment may decrease the price risks in raw-material purchases. An investment in upstream supply-chain works in some cases as a hedge tool against market price variations. The existence of hedging value can be judged, but numerical cost savings are difficult to determine. Third, the involvement in raw-material production may increase the value of the end-product, in this case NExBTL. The value can be increased by being able to specify the sustainable source of raw-materials. Specifying the amount of added value requires market research.

(2) Is controlling the feedstock source critical for the end-product to succeed?

Controlling the feedstock source becomes critical if NExBTL customers or governmental incentives demand a high level of raw-material traceability. Another case where involvement in raw-material production is critical arises if the end product quality is highly dependant on raw-material quality. In both of these cases raw-material production becomes an important source of competitive edge for a biofuel producer.

The first indications of NExBTL markets show that Neste Oil has slight troubles in gaining a green image and satisfying the sustainability demands by sourcing its raw-materials through contracting. However, producing technically high quality NExBTL does not demand any special features from raw-materials. As a consequence, it does not give additional incentive to integrate upstream.

(3) Is there acceptable raw-material available in open markets?

In the case of NExBTL production, the most important feedstock attribute is its sustainability. Technically suitable raw-materials are widely available in global markets as most vegetable oils and animal fats can be used in NExBTL production. Market limitations demanding upstream integration may emerge if other companies competing of the same feedstock start securing their raw-material availability by integrating upstream. Such a case would limit the availability of vegetable oils and animal fats in open markets.

Another case encouraging upstream integration is created if raw-material producers do not have incentives to produce sustainable products. If the growth of demand significantly outpaces the growth of supply, technically suitable raw-material will be available, but at a high price. However, in such a case sustainability of the raw-material may be below Neste Oil's standards and actual raw-material availability scarce.

Summary

In conclusion, the incentives to integrate upstream are created if the feedstock sustainability becomes a highly value adding attribute to renewable diesel or strongly limits the demand; competing raw-material purchasers integrate into upstream and limit the product availability; or integration to upstream is financially attractive from the investment or risk management point of view.

4.6.2 PREFERRED SOURCING STRATEGIES IN DIFFERENT SCENARIOS

A recommendable way to cover raw-material demand is to have either a single global or local main feedstock that satisfies the majority of the demand. Having a main feedstock brings economies of scale to purchasing, eases the coordination of deliveries and stabilizes raw-material quality. Consequently, the recommendations in the following text target to satisfy the need of the main feedstock.

I. The global balance of vegetable oil supply and demand.

- **A.** The growth of vegetable oil demand outpaces the growth of supply
- **B.** The balance of supply and demand remains at its current state

In scenario A the problems are the high prices of all vegetable oils, reduced margins in NExBTL production, low incentives for farmers to pay attention to sustainability issues,

and availability problems due to the pressures to secure food availability. In this case upstream integration would be advisable as vegetable oil producers' margins increase, competing raw-material purchasers have strong incentive to integrate upstream and sustainable cultivation practices could be abandoned in developing cultivation areas such as South-East Asia and South America. The integration should be targeted to a vegetable oil that is financially sound and possible for a biofuel producer to manage. Palm oil emerges clearly as the best alternative due to the lower production costs than in other vegetable oils and the focus of the whole production chain on the oil content. Seed oil (e.g. soybean oil, rapeseed oil and sunflower oil) production would have multiple problems such as the meal sales, crop rotation and traditionally scattered ownership of plantations.

The integration in palm oil production should reach the plantation level, but would not require full ownership by Neste Oil. The optimal solution would be investing in a joint ownership of an established large scale palm oil producer that has already a high amount of mature plantation area and is relatively well focused on sustainability matters. The amount of ownership depends on the investment capabilities of Neste Oil and the needed control to be able to affect company decision making from the board of directors. The investment should be sufficiently large to make Neste Oil able to bring high sustainability standards to the company and to target a large part of the product stream to NExBTL production. In practice the share of ownership could range between 20 % and 80 %. Further research in the possibilities of foreign ownership in Malaysia and Indonesia would be strongly needed as well as assessments of the possibilities to affect company decision making through ownership.

In scenario B the problems arise from the measures that have been necessary to generate a strong increase in supply. Generally, vegetable oils would be available in global markets, but finding oil that has not caused depletion of forests or contamination of soil by high use of machinery, fertilizers, pesticides and herbicides could be difficult. The measures to be taken should be targeted to direct the sustainably produced oils to Neste Oil's use. This does not necessarily require heavy upstream integration and could be managed by efficient contracting. Contracting does not limit the raw-material array to a single vegetable oil as the sourced oil can be varied. However, medium to long-term commitments contracts would be advisable to reduce the need of constant auditing of production practices and to build cooperation between the supplier and Neste Oil.

In practice the available options in contracting cover the sourcing of globally available vegetable oils such as rapeseed oil, soybean oil and palm oil as well as locally available oils such as sunflower oil. The recommended approach would be to bind the contracts for a period of more than two years and to offer cooperation in the area of sustainability to reduce incentives of the vegetable oil supplier to increase production by using unsustainable methods. These investments could be targeted to improvement of production facilities or plantations, to general environmental funds or to the development of local communities. The prices of different vegetable oils should not be compared plainly by market prices, but include also the cost that is required for the sustainability work.

II. The existence of price premiums between different vegetable oils.

A. Different vegetable oils trade at substantial premiums compared to each other

B. The price gaps among vegetable oils become minimal

In scenario A the largest problem would be selecting the right vegetable oil to commit to. At times specific oils and their fractions trade at significant premiums compared to each other, but the next moment the situation may be reversed. For example, it has been noted that RBD Stearin that is derived from crude palm oil has been both more and less expensive than crude palm oil (Appendix A). The optimal approach to this single problem is trading all types of vegetable oils that have the potential to be attractive raw-materials for NExBTL production. By proceeding this way, the least expensive raw-materials at a time could be directed to Neste Oil's own use and the others traded out. The greatest challenges in trading are achieving profitability and being able to trace the feedstock origin. In addition, building long-term commitment with large suppliers may be impossible due to the competition in vegetable oil sales.

Recommended approach is two-folded due to the above mentioned challenges. If certification systems of raw-material sustainability emerge and spread globally, trading only certified cargoes would reduce the needs of traceability. In such a case Neste Oil should create value to the trading by consolidating small, but sustainable streams of vegetable oils, and then selling readily consolidated cargoes to various customers. As a consequence, this would mean that long-term contracts with large vegetable oil producers would not be the main source of feedstock. However, if such certification systems do not emerge, Neste Oil should refrain from large scale vegetable oil trading and select the used main raw-material by approximating the market price developments.

Based on the analysis in this case study, long-term contracts and integration to cultivation do not have significant advantage over each other in scenario A.

In scenario B it would be very demanding to select a single vegetable oil that can serve as the main feedstock for all NExBTL plants around the world. If the price development stabilized to scenario B, it would be advisable to use local raw-materials to a large extent to reduce transportation costs. Naturally, the sustainability and feedstock security would become the main drivers in the raw-material selection. Additionally, the use of local raw-materials would be preferred in the local end-product markets and could thus help to boost the sales. The recommended approach would be to cover the majority of feedstock demand by local sourcing and satisfying the rest by globally sourced raw-materials.

In practice the strategy could work by having a mixture of local sourcing teams at NExBTL plants and a centralized purchasing unit that fills the gaps in raw-material supply. The central organization could be responsible for consolidating raw-material streams from small players such as animal fat producers and then directing the streams to NExBTL plants. In addition, the central unit could take part in vegetable oil trading and work as a market intelligence bank in the area of the raw-material purchasing.

III. Neste Oil's raw-material demand for NExBTL production.

A. Neste Oil requires annually 1,5 million tonnes of feedstock

B. The demand for feedstock is 3,0 million tonnes annually

Throughout this report in both scenarios, A and B, the demand for the main feedstock has been assumed to be 50 % of the total demand. However, the actual percentage for every NExBTL plant will probably be unique. Some of the production units may be located in areas where there is very little local raw-material available or on the contrary, in areas where a single raw-material will certainly be dominating. To asses the global feedstock demand of Neste Oil, it is assumed that 50 % of all the raw-materials will be covered by the main feedstock.

In scenario A, the single largest raw-material accounts for 750 000 tonnes annually. As animal fat production is scattered to small players and will not probably respond to increasing biodiesel raw-material demand, from global point of view the main feedstock has to be a vegetable oil. The main challenge in scenario A would be securing long-term feedstock availability. Sustainability would be an issue, but in scenario A Neste Oil

would not yet be the clear forerunner of any single vegetable oil's use in biofuels. In the integrated position economies of scale could be reached if managing multiple plantations centrally created synergies. In general, raw-material security in scenario A is recommended to be created through long-term commitment in supplier relationships or by own production.

In scenario B the demand of main feedstock is 1,5 million tonnes annually. Despite the selected raw-material, Neste Oil will be a very large player in the markets. This has additional problems compared to scenario A. In scenario B Neste Oil would become a forerunner in using a specific vegetable oil for biofuel production and face all the criticism that is targeted towards the selected oil. Neste Oil would be accused of using unsustainable raw-materials, for example by claiming that Neste Oil's sourcing is a large cause to rainforest destruction or that the company limits the availability of vegetable oils for food. To counter the problem, Neste Oil should strive to have a strong green image. The image is only partly built by actual actions in the sustainability area. The challenge is to create a sustainability story that is easy for people to accept and believe.

In addition to sustainability issues, the large scale would create problems in raw-material flexibility. Even if the main feedstock were sourced through contracts instead of upstream integration, changing multiple contracts to another vegetable oil and trading out most of the agreed deliveries would not be possible in short term. The flexibility would be almost as low as in the integrated position. In addition, for palm oil the geographical concentration is a high risk as nearly all of the production is concentrated in two countries.

To counter the problems that doubling the demand from Scenario A would cause, the recommended approach would be to face the problems and integrate up to the plantation level. Based on the earlier analysis, the target vegetable oil in upstream integration should be palm oil. The strategy should be to make a clear distinction between traditional palm oil cultivation and Neste Oil's practices by overemphasizing sustainable cultivation in all company communication. Naturally, the difference should be backed up by actually increasing the level of sustainability higher than other palm oil producers. If upstream integration is not possible due to the high investment costs, Neste Oil should refrain from becoming a cover picture company for any single vegetable oil. Through contracting Neste Oil is not able to enforce large changes in cultivation practices, but could simultaneously face all the criticism towards the selected main

feedstock. In scenario B contracting works only if the strategy of having a main feedstock is abandoned and multiple raw-materials are used in varying quantities.

4.6.3 SUMMARY OF THE STRATEGIES ANALYSED

The findings presented above are summarized in Table 4-5. Integration to soybean crushing was regarded as a less attractive strategy than the two other strategies in all scenarios. The main reasons to this were the challenges in handling the meal component profitably and finding aid to the sustainability and availability concerns. Integration to oil palm cultivation was considered recommendable over contracting if Neste Oil's feedstock volumes force it to the role of a cover picture company of palm oil. That is caused by the increased availability and sustainability concerns. It was also noted that integration may be the only feasible way to secure raw-material sustainability if international certification systems do not emerge or are not taken into active use.

The results of the case analysis in whole compared to the framework presented in Chapter 3 provide support for using it in evaluating sourcing strategies. Strategies of increasing cooperation with suppliers and integrating upstream proved to be attractive when availability of the commodity is threatened. This can be caused by the risk of a supplier pursuing alternative opportunities and misalignment of supplier's and buyer's incentives. Taking an example from the case study, in palm oil production the future availability of sustainably produced palm oil is unknown and increasing cooperation with suppliers is seen as a tool to guide the development to the wanted direction.

In the case study it was also identified that Neste Oil's raw-material flexibility creates opportunities and thus limits the attractiveness to integrate into the production of certain raw-materials. This supports the view that companies with a wide range of alternative opportunities are not as keen to commit to close relationships with suppliers as the companies with very specific assets. On the other hand, when it is projected that a very specific raw-material is needed in the future, companies have more incentive to integrate upstream. In the case study it was respectively concluded that sustainability is an example of an attribute that can create strict specifications for an otherwise general commodity such as vegetable oils.

Table 4-5 The applicability of the strategies in different scenarios on scale 1-5

	Sourcing palm oil with contractual relationships	Upstream integration to oil palm cultivation	Acquiring soybean crushing capacity
I. The global balance of vegetable supply and demand			
A. The growth of vegetable oil demand outpaces the growth of supply	2	4	2
B. The balance of supply and demand remains at its current state	4	3	1
II. The existence of price premiums between different vegetable oils			
A. Different vegetable oils trade at substantial premiums compared to each other	3	3	2
B. The price gaps among vegetable oils become minimal	3	2	2
III. Neste Oil's raw-material demand for NExBTL production			
A. Neste Oil requires annually 1,5 million tonnes of feedstock	3	3	2
B. The demand for feedstock is 3,0 million tonnes annually	2	3	1

scale of applicability: 1 = very low, 2 = low, 3 = medium, 4 = high, 5 = very high

A major limitation in the support found is that it comes from the vegetable oil markets. The same markets have been used to build the framework and as a consequence, further research is required to validate the use of the framework in other evolving commodity markets.

5 CONCLUSION

The objective of this study is to form a framework that can be used to support decision making regarding sourcing strategies. The tool created is applicable in its current form in evolving commodity markets. To achieve the aim of this study, two specific questions have been answered. The first question is: "What are the intermediate sourcing strategies that exist between vertical integration and spot markets?" An answer to this question was sought in Chapter 2 which advanced through the literature on sourcing strategies and transaction cost economics to a proposal of dividing the hybrid modes of organization to contractual relationships, partnerships and equity-based alliances. The second question is: "What kind of internal and external circumstances encourage using specific sourcing strategies?" This question was deemed to be very difficult to answer by the variables of transaction cost theory. As a consequence, attributes of a specific market were selected to link the theory to the practice. The answer to the question was formed into a framework that suggests different types of sourcing strategies in evolving commodity markets depending on the attributes of the markets and the sourcing company.

The framework presented in this study is not applicable to a wide range of different companies and markets, but has novelty value as one of the few attempts to form a tool that points out optimal sourcing strategies. The main problem in creating a framework that suggests different modes of sourcing is that every company and market is different from each other. As a consequence, a framework can at its best support the decision maker only in some aspects. This study aims to provide this support on the strategic considerations regarding alternative modes of sourcing. Whereas strategic reasoning can be generalized to cover companies operating in similar markets, company specific financial calculations have to be still carried out. This leads to the remark that finding a unified way of calculating transaction costs for different companies and then comparing them to a set of reference values most likely would not work as an optimization method for sourcing strategies. As a consequence, regarding sourcing strategies transaction cost economics is expected to remain as a theory that explains company behaviour mainly retrospectively.

A major part of this study discusses the company case of Neste Oil. In addition to using the market analysed in the case study in forming the framework, the analysis itself

provides valuable insights to a new area. The entire biofuel industry is in its early stages and has received mainly technical attention. The strategic analysis in this study goes beyond the technical aspects to find the market dynamics that especially the producers of biomass based diesel find important. One of the main questions in the biofuel markets is the sustainability of the end-product. Whereas cleaner traffic fuels have in the past meant decreased tailpipe emissions, the consumers are now concerned with products' environmental impacts during the entire life cycle. This brings pressures to sourcing because a fuel producer has to be now able to guarantee the sustainability of the product from plantations to the tailpipes of vehicles.

This study analyses three different sourcing strategies from Neste Oil's point of view for the period between 2010 and 2015. This era has been selected because the next generation of raw-materials that do not compete with the food industry are projected to be available in large scale near 2015. Sourcing palm oil with long-term contracts is seen applicable when the availability and sustainability concerns remain at a medium level. The second alternative strategy, integration to oil palm cultivation, proved to provide help in controlling these issues, but was at the same time considered complex to carry out during this relatively short time period. The third strategy analysed, integration to soybean crushing, was judged to be unattractive for a biofuel producer due to the high importance of selling the meal component and its questionable aid to availability and sustainability concerns. The immature nature of the biofuel industry led to gathering information for the case study from various types of sources. The methods included discussions with industry specialists in Neste Oil's organization and in the raw-material markets. This information was supplemented with multiple published reports and market analyses.

The results of the case analysis showed support for the framework presented in this study. The main variables of transaction cost theory, uncertainty and asset specificity, were moulded into different scenarios in the framework. The market scenarios concentrated on the availability concerns and the alignment of the incentives in the supplier-customer relationship. According to the case study, when availability concerns rise and the incentives become misaligned, the attractiveness of tying the sourcing company to the supplier by increased cooperation and ownership linkages rises. The scenarios in the framework concerning the focal company emphasized the effect of sourcing on the end-product value and alternative opportunities to use the assets

available. The case study demonstrated that raw-material and process flexibility do not support increased integration with the supplier. On the contrary, if the end-product value was highly affected by the raw-material attributes, integration became attractive.

The main directions for further research should be to evaluate the proposed framework in other evolving markets and to adapt the framework to a planning process of sourcing strategies. From the case perspective, biofuel industry would benefit from multiple types of studies. The swiftly changing environment calls for updates to the projections presented in this study, but also for deeper understanding of the market dynamics. An especially interesting area of research would be the financial comparison of biofuel producers that are integrated into the raw-material supply and companies that rely only on contracting.

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APPENDIX A

THE SUPPLY CHAIN OF PALM OIL

The supply chain of palm oil consists typically of three separate facilities that process fruits of oil palms into refined fractions of palm oil. Figure A-1 portrays how the fresh fruit bunches of oil palm are processed into different palm oil products.

(A) The first step is *the mill process,* where fresh fruit bunches are turned into crude palm oil and palm fruit kernels. The side products of this step are empty fruit bunches, fibre from the crushed fruits and shells, and palm oil mill effluent. Palm oil mills are an integral part of oil palm plantations as the fresh fruit bunches have to be processed right after harvesting.

(B) Following the flow of crude palm oil, the next step is *refining*. This process outputs refined, bleached and deodorized palm oil. This RBD Palm oil can be fractionated to Olein and Stearin. The deodorizing part of the refining process removes free fatty acids from the oil and they are processed into palm fatty acid distillate, i.e. PFAD.

(C) Turning to look at the product flow of the kernels, the process following the separation from the fruit is *crushing and oil extraction*. This leads to the production of palm kernel oil and the side-product, palm kernel cake, PKC (i.e. palm kernel expeller, PKE). Palm kernel oil can be refined like crude palm oil producing also PFAD as a side product.

PALM OIL GRADES

The characteristics of different palm oil grades define their suitability for NExBTL-production.

Crude palm oil can be used in case it is pre-treated prior to the NExBTL-process itself. The pre-treatment removes impurities from the oil, for example phosphor and metals. In its unrefined form crude palm oil has a limited number of uses. It can be used in a few technical applications such as soap production and energy creation.

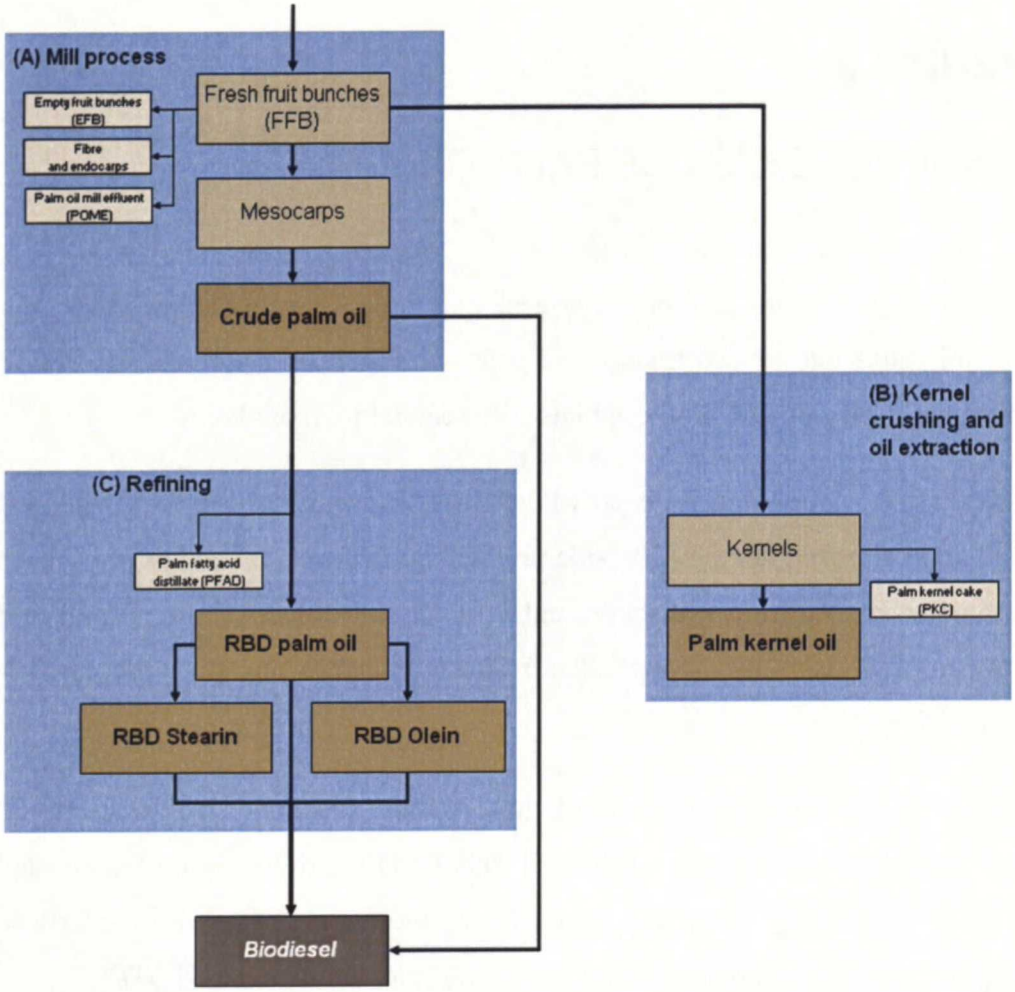

Figure A-1 Palm oil processing

By using *RBD (refined, bleached and deodorized) Palm oil* and its fractions, *Olein* and *Stearin,* the pre-treatment process can be bypassed in NExBTL production. RBD products are targeted for the food industry and thus do not contain impurities. Most common edible uses of refined palm oil are margarines, shortenings, frying fats, cooking oils and vanaspati (vegetable ghee). Edible uses accounted for about 80 % of the global palm oil demand in 2006 (USDA, 2007). The remaining 20 % was consumed in various oleochemical uses and other technical applications such as biodiesel production. The level of refining provided by palm oil refineries exceeds the requirements of pre-treatment for NExBTL-production.

Palm kernel oil is a lauric oil that has features similar to coconut oil. In NExBTL-production using lauric oils results in a higher petrol yield and lower diesel yield which is an unwanted result. However, a small proportion of lauric oils among other feedstock could be used to enhance specific properties of the end product. Today palm kernel oil

is used in confectionaries, margarines and oleochemicals. Palm kernel oil would be subject to pre-treatment in its unrefined form.

Palm fatty acid distillate (PFAD) is a side-product that contains a high amount of free fatty acids. They have been separated from crude palm oil or palm kernel oil in the deodorizing part of the refining process. As the percentage of free fatty acids is limited by the NExBTL-plant, PFAD could only be used in small proportions in a blend with other feedstocks. PFAD is used for example in soaps, cosmetics and oleochemical applications.

The prices of different palm oil grades are highly correlated as Figure A-2 shows. Palm kernel oil differs from other palm oils in terms of pricing since it is strongly linked to other lauric oils such as coconut oil through its differing applications. The differentiating pricing of palm kernel oil is clearly visible from 2004 to 2007.

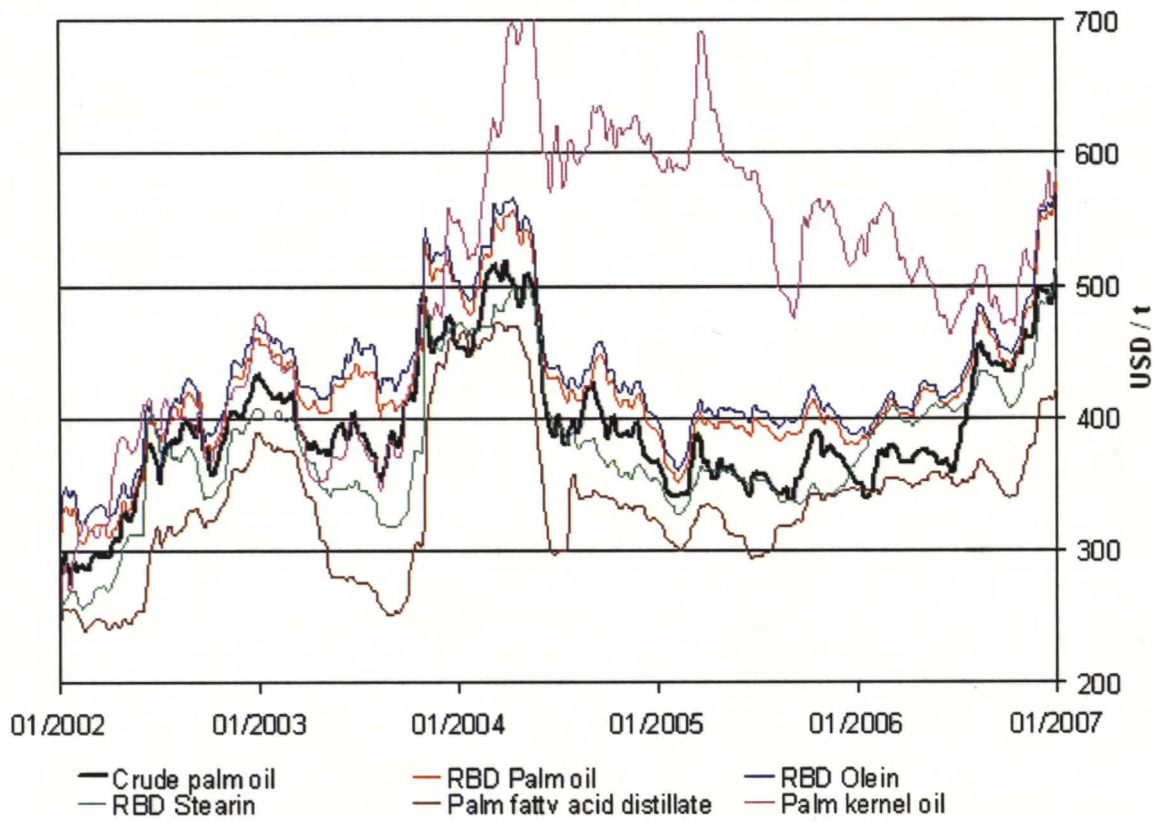

Figure A-2 Prices of different palm oil grades (Reuters, 2007)

Figure A-3 graphs the premiums and discounts of products derived from crude palm oil. RBD Palm oil and its main fraction RBD Olein have traded at a moderately volatile premium from 2002 to 2007. The average premium compared to CPO for RBD Olein has been USD 38 per tonne and respectively USD 29 per tonne for RBD Palm oil. The

secondary fraction, RBD Stearin, has sold at a volatile price compared to crude palm oil. The mean difference has been a discount of USD 13 per tonne. However, the volatility of the price has occasionally caused RBD Stearin to reach even the same premium as RBD Olein. PFAD has been the least expensive fraction through the whole era. The average discount compared to crude palm oil has been USD 55 per tonne. Furthermore, the volatility of PFAD's price difference is clearly the highest among these palm oil products.

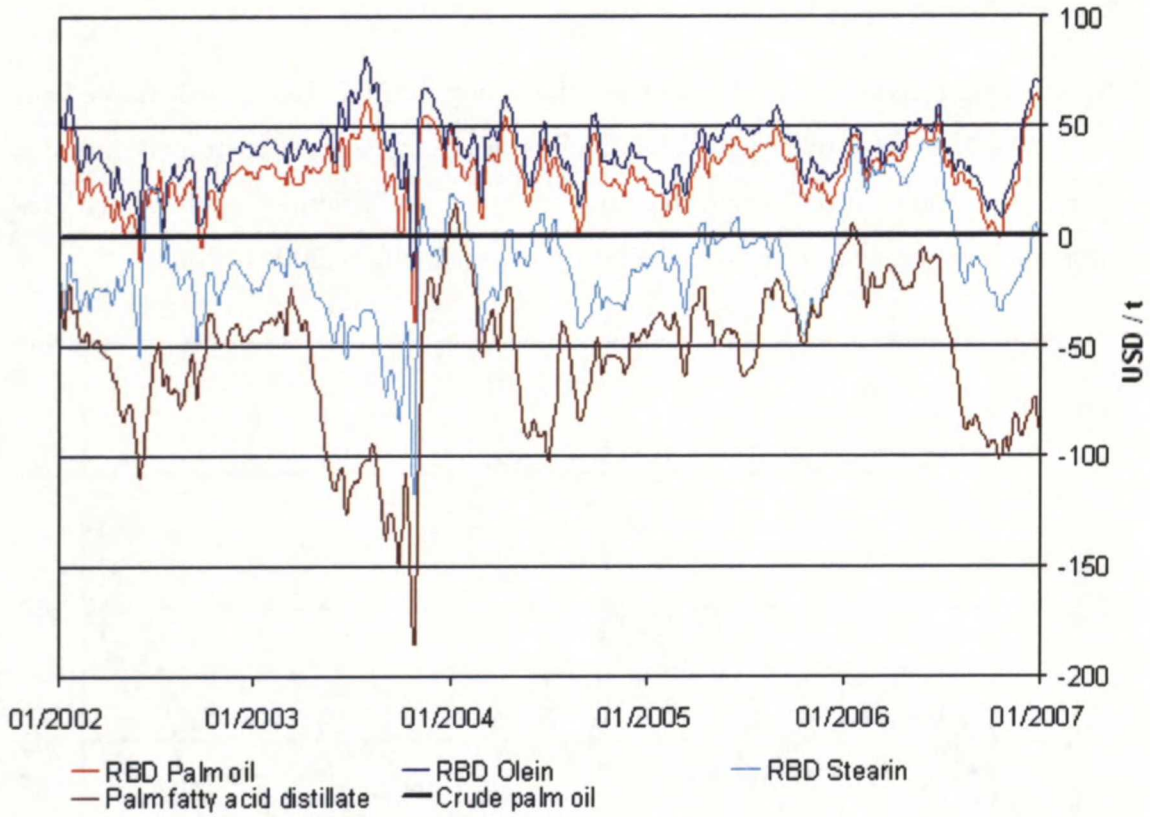

Figure A-3 Price differences of different palm oil grades (Reuters, 2007)

ECONOMIES OF PALM OIL PROCESSING

By incorporating price information to the palm oil process chart, the value creation in the supply chain of Malaysian palm oil can be examined. Figure A-4 has been calculated with average prices of the first quartile in 2007 based on Malaysian delivery (Reuters, 2007). The percentages of value added have been calculated by comparing the value of inputs and outputs, except in the case of the plantation, where estimated production costs have been used instead of input costs for illustrative purposes.

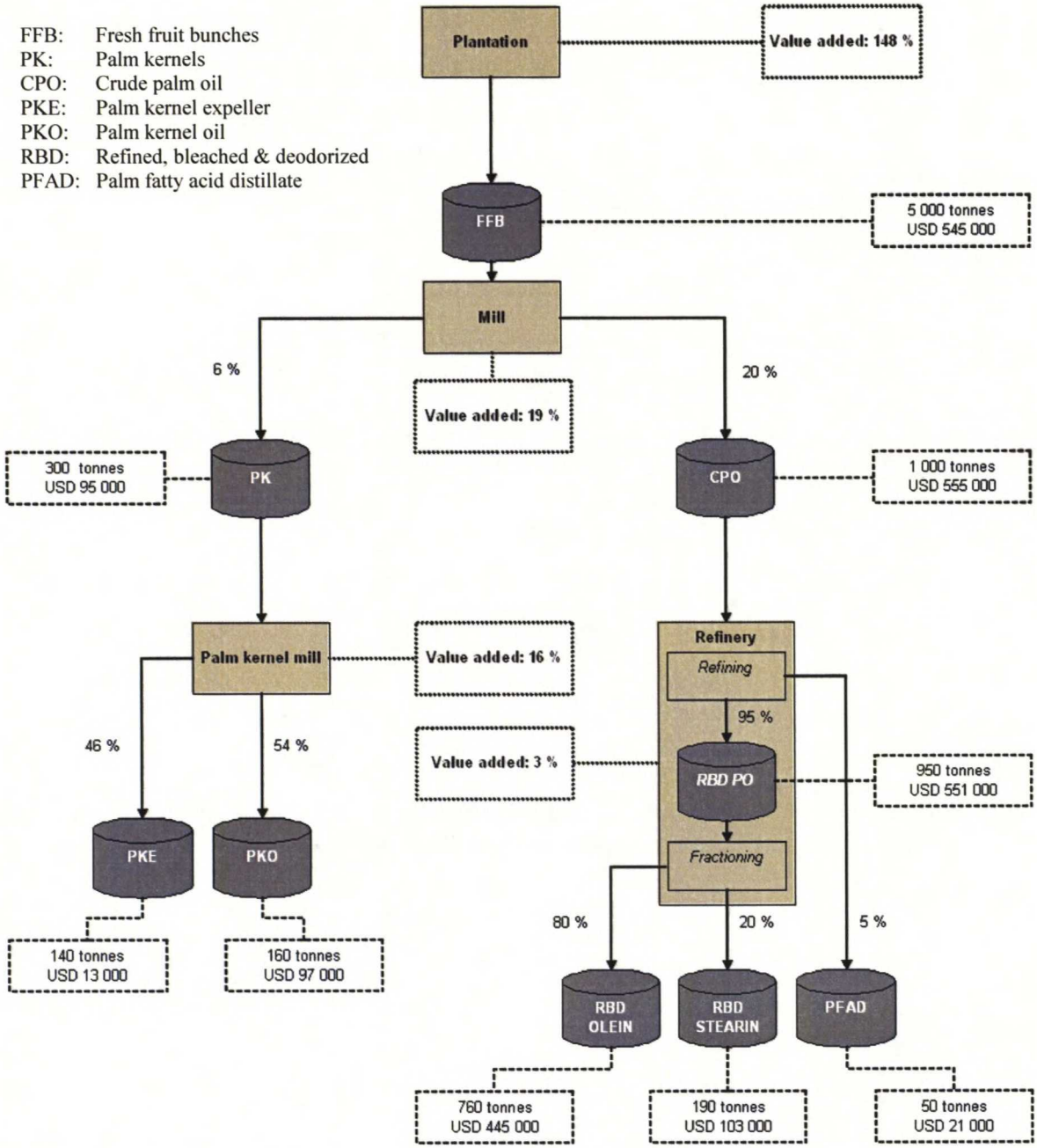

Figure A-4 Value creation in palm oil supply chain 1-3 / 2007

Figure A-4 clearly shows that the value in palm oil supply chain is created in the first steps. In the usual case the same company controls both the plantation and FFB milling activities that combined add almost 200 % value to the inputs. Exceptions to this are the smallholders of plantations who sell their production to nearby mills at a local price level, which is determined by the availability of milling capacity in the area. Generally there is plenty of milling capacity available in SE-Asia which is portrayed by the high reference prices for fresh fruit bunches set by Malaysian Palm Oil Board and low utilization rates of mills in Malaysia (MPOB, 2007).

For larger palm oil corporations the price of fresh fruit bunches is merely a factor in dividing the profit between operations. Some of the plantation and milling corporations are not integrated into the area of palm oil refining which seems to struggle at current prices. The refining process adds only 3 % to the value crude palm oil.

Most of the demand for refined palm oil products is concentrated for the Olein-fraction. At current price levels the fractioning process in the refinery is done at a negative margin while it has been barely value adding during 2002-2006. The constantly rising demand for palm oil is as well mostly derived from the rising demand of RBD Olein for traditional uses in food production and the new application of producing FAME-biodiesel. As a consequence of the poor margins, palm oil refiners have a strong incentive to integrate upstream or downstream in the supply chain and to seek new markets for the by-products, RBD Stearin and PFAD. Figure A-5 presents a view of the value chain by Lavigne (2007). His analysis supports vertical integration from the refiner's and biodiesel producer's position to either feedstock production or retailing of the end products.

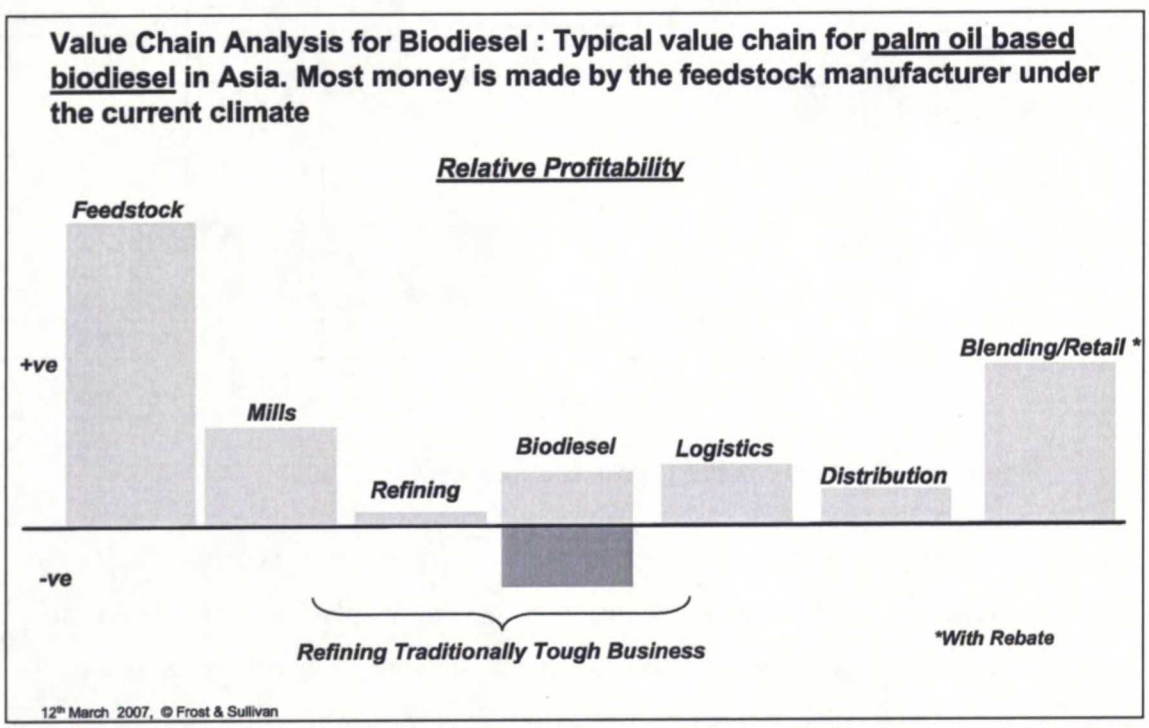

Figure A-5 Value chain analysis for palm oil based FAME (Lavigne, 2007)

Clay (2003) states that palm oil market is evidently becoming more vertically integrated. His opinion is that traders and processors will continue to integrate upstream provided that the plantation and milling industry remains relatively low in risks. The

large producers of vegetable oil based food products use varying supply chain strategies. Unilever has usually been involved in the cultivation of its vegetable oil sources, but has sold its oil palm plantations in the beginning of this decade. Nestlé has integrated in the opposite direction as its operations run from refining into retailing of finished goods. As written by Clay (2003), food processors see the integration through ownership as a possible way to understand and defend the social and environmental impacts of the products they sell. The global agriculture conglomerates Cargill, ADM and Bunge cover also a wide range of operations by being in direct contact with the farmers.

APPENDIX B

THE SUPPLY CHAIN OF SOYBEAN OIL

The largest fundamental difference between palm oil and soybean oil is that soybeans are primarily cultivated for animal feed production instead of the oil content. As animal feed, soybean products are high in protein content and relatively competitively priced (Clay, 2003). The supply chain of soybean oil is more straightforward compared to palm oil as it usually includes only one major processing facility, the soybean oil extraction and refining plant, i.e. soybean crushing plant.

Figure B-1 shows a typical supply chain of soybean oil processing. This view separates the chain into four facilities, but in practice many varieties exist. In case it is logistically favourable, it may not be necessary to use a grain elevator (A) as a middleman to consolidate product streams from plantations. Mills and refineries are usually located at the same plant (B & C). Alternatively, the refining unit may be located at a food processing facility or as an independent unit. Carlson (2006) informs that today in United States 85 % of refining capacity is located at the mills. Similarly, the meal processing plant can be integrated to a mill (B & D) or to a combination of a mill and refinery (B, C & D). Products and side-products of each facility are summarized below.

(A) *The grain elevator* is a logistics operator that specialises in gathering soybean streams from the individual farmers. The main functions are to provide storage space to balance fluctuations in supply and demand and to ship out consolidated cargoes. These silos are usually located at ports or railway terminals to enable large scale transportation. Soybeans are dried either at the farm or at a grain elevator. Another similar step is cleaning the beans, which may be repeated multiple times in the supply chain. The target is to remove soil, pebbles, plant and insect waste, weed seeds, and broken soybeans that may remain among other beans after threshing.

(B) The first step of actual soybean processing takes place at *the mill.* The oil is separated from the solid mass by solvent extraction or mechanical extraction (i.e. pressing, expelling). Milling outputs soybean hulls as a side-product. They are removed before oil extraction to increase the relative protein content in soybean meal. Dehulling is not, however, exercised at every mill. The actual oil extraction outputs two products

for further processing, crude soybean oil and soybean meal. Soybean meal is in the case of solvent extraction called spent flakes (as in Figure B-1).

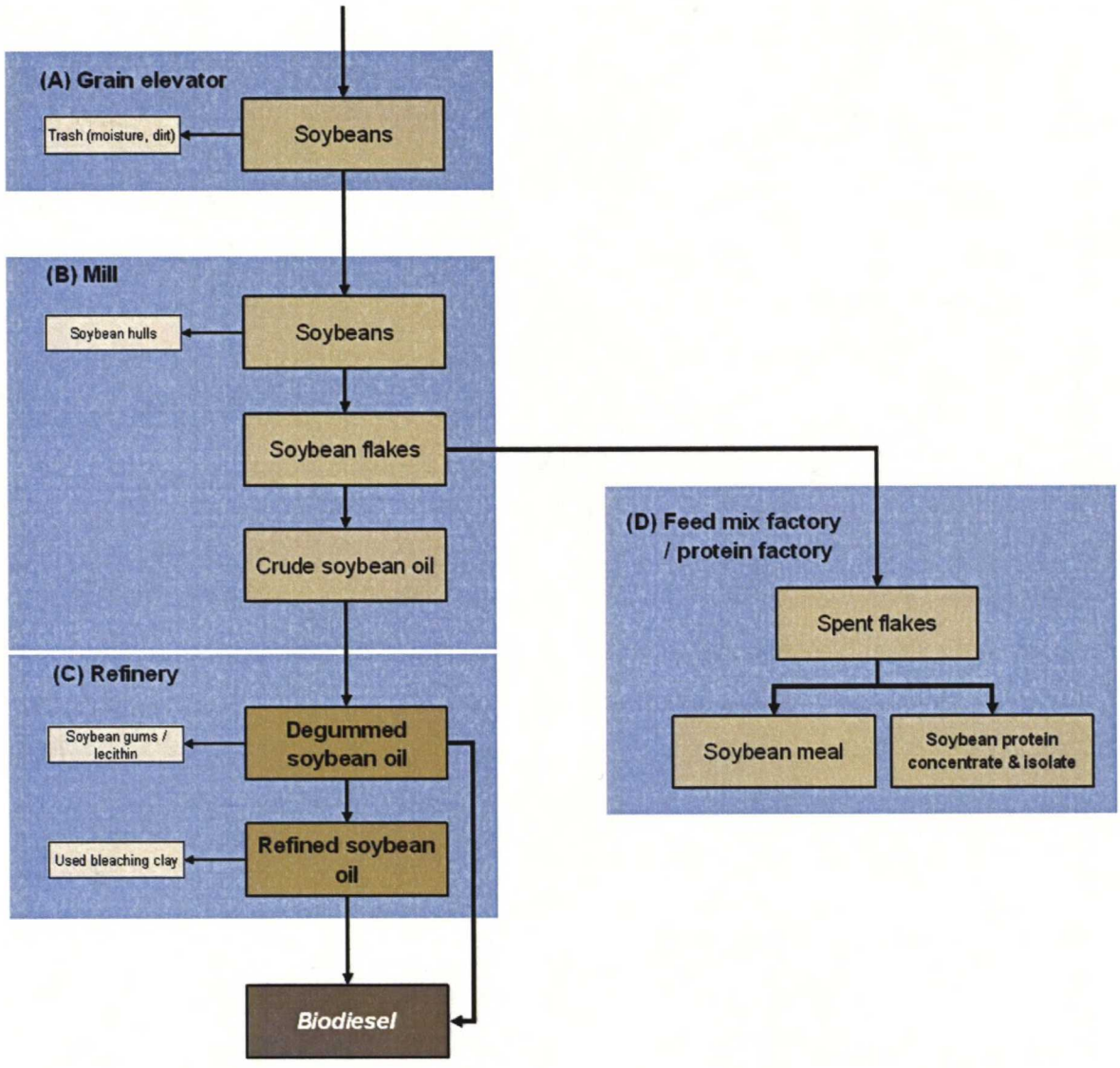

Figure B-1 Soybean oil processing

(C) The next processing step for crude soybean oil is *refining.* First, crude soybean oil is degummed which means removing lecithin (phosphates) from the oil. Depending on the method used, the output is degummed or super degummed soybean oil. Following degumming, the oil faces further refining. The steps in the refining are neutralization, bleaching and deodorizing. Used bleaching clay, the side product of bleaching, can be used for example in composting. In some cases only part of the refining steps may be used if the target is to produce a special grade of soybean oil.

(D) Even though not directly connected with oil production, the meal side of soybean is important from the financial aspect of soybean processing. The processing of animal

feed is done at *a feed mix factory* and the manufacturing of other protein products in their respective factories. Most of the soybean meal is turned into animal feed, but a part of soybean flakes is processed for food product use. These are for example soy protein concentrates and isolated soy protein.

SOYBEAN OIL AS NEXBTL FEEDSTOCK

As opposed to palm oil, the global markets do not quote even the cash prices of different refined soybean oil grades. Thus selecting the optimal grade of soybean oil for NExBTL production should be based on how far the product is refined and how much the refiner charges premium compared to degummed soybean oil for each refining step. The premium is bound to fluctuate among producers since the capability to output a product from the middle of the process varies and the used refining technology finally determines the types of products that result.

Crude soybean oil directly from the mill is rich in impurities and is not refined to any extent. It has a high phosphoric content and is regarded as possible, but challenging feedstock for NExBTL production. Crude soybean oil with all its impurities would put pressure on the logistics systems and create need to find use for the side product lecithin that is added to the meal or sold separately from the soybean processing plants. Technically the pre-treatment can be designed to accommodate using crude soybean oil.

Degummed and super degummed soybean oil result after separating lecithin from the oil. The difference between degummed (often referred to as "crude degummed") and super degummed oil is the share of phosphor content. The amount may vary greatly between producers, but one reference shows that for the former it is 200 ppm and for the latter 10-30 ppm (Wilde et al., 2002). Degummed soybean oil has only limited consumption, mainly in few technical uses. It is in practice the lowest level of soybean oil suitable for NExBTL production, but has to go through pre-treatment before processing.

Refined soybean oil exists in several different specifications depending on the application that it is targeted for. Refined soybean oil is used as an ingredient in various food products and in different food processing applications. Combined these uses account for 95 % of all soybean oil use (USDA, 2007). The normal refining process includes separation of the free fatty acids and is followed by neutralization, bleaching

and deodorizing. The result is soybean oil that is not subject to pre-treatment before NExBTL production.

ECONOMIES OF SOYBEAN PROCESSING

The analysis of soybean oil value chain starts by a view at the prices of soybeans and its products. Figure B-2 plots the prices of these commodities for a period of over 30 years.

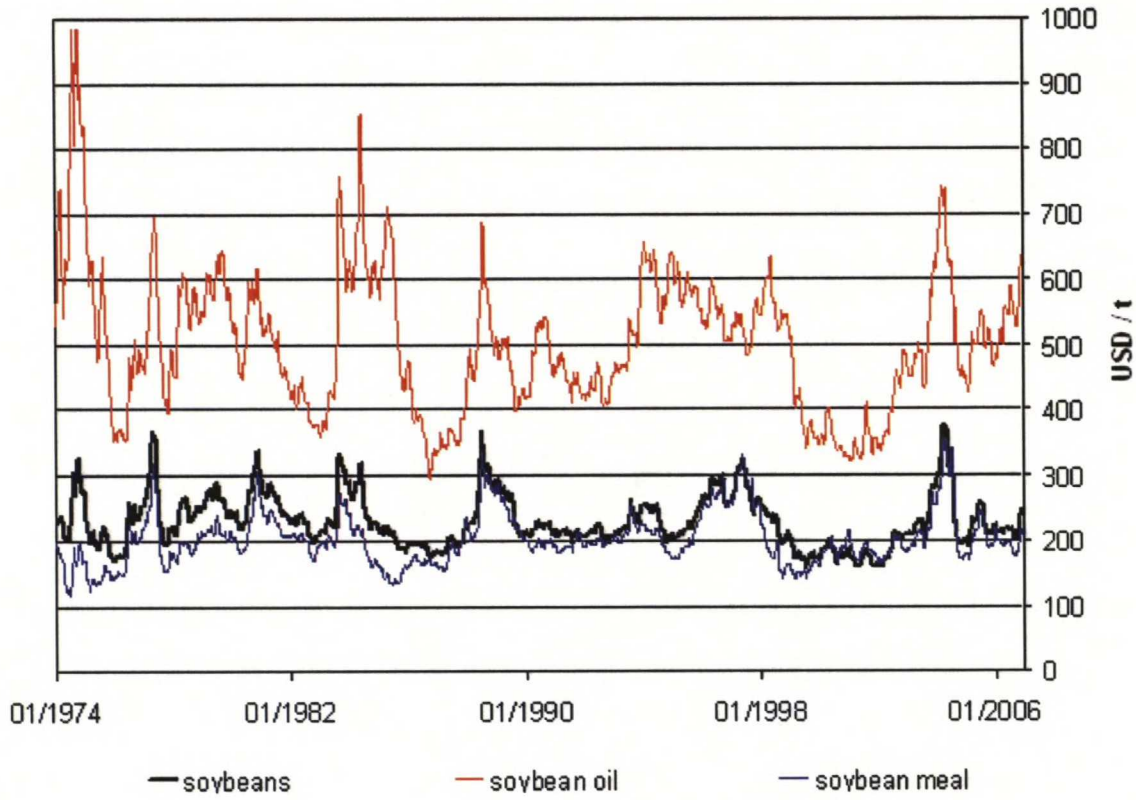

Figure B-2 Prices of soybeans, soybean meal and soybean oil (CBOT, 2007)

The graph above provides two interesting insights. First, the prices of soybeans and soybean meal have moved in concert since the end of 1980's. The close bond results from the fact that soybeans are mainly cultivated for the meal. Until recent years, the price of soybean oil has had only little effect on the value of soybeans. Biodiesel hype has strengthened the price of soybean oil in recent years as the graph well shows, but interestingly the price of soybeans has remained rather steady. Second, even though the price effect is small, the importance of soybean oil to the economics of soybean crushing is significant. As Figure B-2 shows, the margin in producing soybean meal can be very small and profitability depends heavily on other aspects such as value created by logistics. In these circumstances, the side income stream from soybean oil has a significant role in making soybean processing profitable.

The price information combined with soybean production chart presents the economic standing of soybean processors in USA. This information is presented in Figure B-3. The calculations have been based on the average prices of the first quartile in 2007. The input costs used for the plantation are full production costs (Soy Stats, 2007). Refining, excluding deodorizing, is projected to add USc 2 per pound value to CBOT (2007) soybean oil quotations (Carlson, 2006). This converts into USD 44 per tonne. Carlson (2006) approximates the value of hulls to be 40 % of the meal value. Value of lecithin moves currently around USD 948 per tonne.

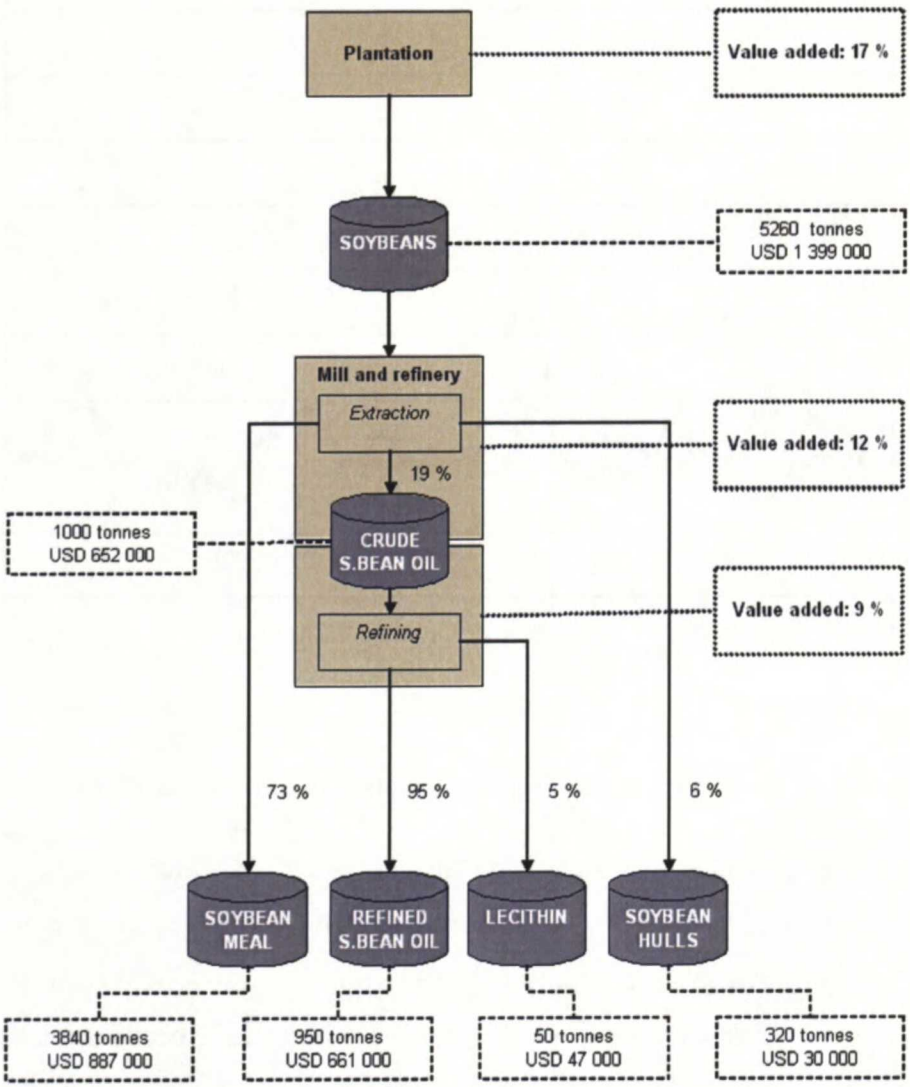

Figure B-3 Value creation in soybean oil supply chain 1-3 / 2007

The markets for soybeans and soybean products are fairly competed and thus margins are distributed more evenly than in the supply chain of palm oil. A contributing fact to the balance may be that some soybean processors, especially in Europe, are able to use also other seeds to produce and refine oil. At times when the margins for soybean oil

production are low, they are able to use rapeseeds and sunflower seeds as feedstock. This is a major difference to palm oil processing, where the mill is directly connected to the surrounding plantations and does not have alternative raw-materials. Another important balancing attribute of soybeans compared to fruits of oil palm is the possibility to store the beans. Whereas oil palm's fresh fruit bunches have to enter the mill in 48 hours from harvesting, soybeans can be stored for a period of 18 months before the quality starts to degrade.

According to Figure B-3, most of the revenue in soybean processing comes from the meal sales. However, the rising demand for vegetable oils may change the picture if their prices rise substantially. At the moment refined soybean oil accounts for 41 % of the income of a soybean processor that has both milling and refining capacity. Soybean lecithin and hulls are side products that contribute about 5 % to the revenue.

Soybean industry in USA is highly consolidated as Carlson (2006) explains. The milling capacity is controlled by four large players: ADM, Bunge, Cargill and AGP. The crushing capacity of these conglomerates amounts to over 80 % of the total capacity in USA. These companies control supply chains from grain elevators to the production of refined oils and animal feed products. The business in South America is yet to reach maturity and many players exist. However, ADM, Bunge and Cargill have a steady foothold in South-America as well. These companies and Coinbra, a Brazilian subsidiary of Louis Dreyfus, control combined 43 % of Brazilian crushing capacity (Ellis, 2006).

The division of tasks between food companies and soybean processors has been moving to the direction where food producers concentrate more on marketing and brand management instead of physical operations. As the few multinational corporations process the product from beans to refined oil, there is very little demand for the actual crude degummed soybean oil that is quoted in commodity markets. The current FAME producers in USA are not bound to change the picture either as only few have pre-treatment capacity required to use crude soybean oil (Carlson, 2006). Consequently, in USA soybean oil methyl ester is generally produced from refined and bleached soybean oil.